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AQUATIC HABITAT INVENTORY PROCEDURES

Neil B. Armantrout

The Bureau of Land Management, U.S. Forest Service, and Oregon Department of Fish and Wildlife have cooperated in development and implementation of aquatic habitat inventory procedures. In 1973, the three agencies agreed on a specific method of inventory to be used by the three agencies. As a result of changes in mission, different needs within agencies, and the interests and biases of individual biologists, the agreed-upon method has been supplanted by a variety of inventory systems developed by individual biologists. Because of the need to revise the original procedures, the three agencies began a review of possibly inventory procedures. One result of this review was the symposium on Acquisition and Utilization of Aquatic Habitat Inventory Information held in October, 1981, in Portland, Oregon. The results of that symposium will be published under a separate cover.

As a result of the discussions within Oregon, and with some biologists in other states, it was decided that a new approach should be tried. Existing procedures have a generally limited applicability. It was not considered reasonable to expect acceptance of a single inventory procedure for all uses by all agencies.

Aquatic habitat is fairly limited in the range of habitat components usually measured. While there is a broad range of possible components, including terrestrial components such as geomorphology, climate and riparian vegetation, most inventory systems contentrate on 20-30 components considered most important for fish habitat. The measuring of these components, and the way in which the information is summarized, has led to the pleuthoria of procedures now available. Attempts have been made to develop a single procedure, but all such efforts have ended in failure. Each agency and many units of agencies have elected to utilize their own system, preferring a system tailored to their specific needs rather than accepting a more generalized system.

Several things contribute to the reluctance to accept a uniform system. One is the interest and biases of the individual or agency, that favors a particular system rahter than being willing to compromise on a common system even if it would facilitate the interchange of information. An importnat factor is the differences in agency mission, and the purposes for which information is c ollected. The differeing levels of information needed, from general, broad land-based studies to detailed research influence the way in which information is colected and the intensity of the procedures.

Inventory systems are mostly based on some form of ground inventory, usually using a section or transit method of measurements. The measurements may be direct, using insturmentation, or ocular. Individual compoenents are then given as a total, as with amount of spawning area, or as a ratio or percentage, as in percentage pool. The individual components are summarized in some fashion, with inferences then made from the component values, either directly, or using some evaluation form or procedures.

While cooperation and interchange of ideas occurs, data from different sources often cannot be interchanged. Selection of habitat components, units, and acquisition proceudres differ, not allowing direct comparisons. Because of the inventory procedure design, the information is of limited scope, and the data has little utility beyond the immediate purpose of the inventory. Broader analyses and data comparisons are often not possible.

Ideally, all agencies in an area should be using the same procedures. The information thus obtained would have a much- wider utility than just the immediate needs of the gathering agency. It is seldom that the information is useful only by one agency and for a single purpose. It is therefore desireable to have an inventory system that fits the needs of participating agencies, and at the same time is in a form that can be used by other agencies or groups.

In order to have wide utility, and inventory system needs to satisfy c ertain criteria:

1. It needs to be adaptable to a variety of missions, from land use allocations to environmental assessments. It should be adaptable to the basic program needs of cooperating agencies.

2. It should be funcitonal on several levels. The information should be useful for detailed studies as well as broader resource problems. While the intensity of information collection and the degree of detail will vary with level, the system itself should be adaptable to the different levels.

3. The information should be replicable. This refers not only to the ability of others conducting invnetories in a given area to produce the same values for thE same components, but also for components to be comparable through time to show trends and changes.

4. The same components should have comparable meanings among areas. The definitions for specific components should be the same, so that it is accepted by all workers. Thus components measured in different areas would ~~bed~~ have some comparability.

5. The system should be adapted for ADP use, so that the information can be stored, processed, and analyzed using automatic data techniques.

6. The information system should contain components that will fill the needs of different agencies and different needs within agencies. It should provide useful information for any work with the aquatic systems.

No single inventory procedure can be adapted to meet all of the necessary criteria. Instead, an option approach is to use a standard methodology for habitat components, but to leave to individual biologists the design criteria for the inventory procedures. Under a standard methods, definitions for habitat components would be agreed on, and, if suitable, techniques. Attached is a copy of a catalogue of components that could be considered. Other components can be added as needed.

In use, the system would function similar to the STORET water quality system of the U.S.G.S. Individual agencies or biologists would select the components which they feel would provide them the information they need to achieve their mission. The information would be collected according to a recognized ~~system~~.procedure. Information would be recorded in a standard format, one suitable for ADP procedures.

The standard methods, as written, were prepared for use in Oregon. The individual codes can be changed depending upon location. The system suggested is based on the premise that the storage and retrieval of inventory information will be done by computer, and will be eventually coorelated with an analytical capability. Information collected would be coded as to location, and would be then stored in the computer based on that location code. Subsequent information gethered in the same location would then be added to the file. Each data file would be additive, with information being added as ~~he~~ acquired. The information would be retrieval in the same way, with individual components for any water code be available on call-up. The system could be interfaced with WATSTORE and STORET by using similar location codes so that a complete data file would be available for any given location.

A similar system is already operation in the state of Montana. The system suggested here is developed from the Montana system, mostly by enlarging to cover additional components needed in themore diverse habitats of Oregon.

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A similar system is already operation in the state of Montana. The system suggested here is developed from the Montana system, mostly by enlarging to cover additional components needed in diverse riverine habitats of Oregon.

A. FLOWING WATER

Flowing waters are streams and rivers, and include intermittent and ephemeral as well as perennial waters.

I. IDENTIFICATION

Information collected in this category serves to identify the water being inventoried, the portion of the water covered by the inventory, its location, peronnel involved, and other administrative information.

1. Water Name. Name of the stream or river being inventoried.

2. Tributary To. Name of creek, river, or other body of water into which the survey water flows.

3. Basin. Name of major drainage basin in which the water is located.

4. Reach and Section. The reach is the portion of a stream covered during the inventory. Ideally a reach will be a length of stream with distinct physical characteristics. A typical stream will have several to many reaches. Reach boundaries will preferably be identified by physical features readily located by others. When a reach does not being or end at an identifiable physical feature, such a feature at another location may be selected as the reference point and the distance to the end of the reach indicated. For example, a description of the start of a reach may read "one-half mile above highway bridge."

   While a single reach is covered in the inventory, for greater facility in describing the habitat the reach may be broken into a number of sections. The number of length of the sections will be determined by the inventory needs and should be given. The inventory description for a reach would then be a summary of the information from each section.

5. Administrative Codes. Administrative codes are often assigned to streams. These are often based on numerical designations of basins and major waters. Any such codes in use by the agency doing the inventory, or for other agencies which may be concerned with administration of the stream, should be given. It is recommended that any administrative codes based on basins use the Hydrologic Unit Code adopted by U.S.G.S. and the state of Oregon water resources.

   The Hydrologic Unit Code uses an eight digit number to identify stream locations. For example, the number:

   17090006

   17 indicates the Region, 09 the Subregion, 00 the Accounting Unit and 06 the Cataloging Unit.

   Three Regions are found in Oregon:

   16-Great Basin
   17-Pacific Northwest
   18-California

   Ten Subregions are found in Oregon, and include:

   16-Great Basin REgion
   04-Humboldt Subregion
   17-Pacific Northwest Region
   05-Snake River, above Hell's Canyon
   06-Lower Snake
   07-Columbia River Above Bonneville
   08-Lower Columbia
   09-Willametter River
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   For additional Hydrologic Unit codes, see Appendix I.

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   For additional hydrologic unit codes, see Appendix I.

6. Coordination. For each inventory reach or section, a system of coordinates should be given. The coordinates are typically given for the starting point of the inventory, but may also include the ending point. Both latitude-longitude and township, range and section should be given.

7. County. The county or counties in which the inventory reach is located should be given. The name of the county may be written or, a code used. The following county code is suggested:

01-Baker	13-Harney	25-Morrow
02-Benton	14-Hood River	26-Multnomah
03-Clackamas	15-Jackson	27-Polk
04-Clatsop	16-Jefferson	28-Sherman
05-Columbia	17-Josephine	29-Tillamook
06-Coos	18-Klamath	30-Umatilla
07-Crook	19-Lake	31-Union
08-Curry	20-Lane	32-Wallowa
09-Deschutes	21-Lincoln	33-Wasco
10-Douglas	22-Linn	34-Washington
11-Gilliam	23-Malheur	35-Wheeler
12-Grant	24-Marion	36-Yamhill

8. Ownership. Indicate the ownership of the inventory reach, giving stream distance or percentage ownership for each category of owner. In cases where there are withdrawals, for example, power withdrawals by WPRS or the Corps of Engineers, indicate both the ownership and the purpose of the withdrawal. The following categories of ownership may be used: Appendix II

9. Administrative Units. The administrative unit indicates management ~~units~~ areas set up agencies influencing the aquatic resources. The inventory should indicate the name of the administrative unit or units that includes the inventory reach.

10. Special Designation Areas. Special designation areas are areas which have been set aside or withdrawn for a specific purpose or to preserve selected values. Codes:

01-Wilderness areas	07-Area of Critical Environmental Concern
02-Primitive areas	08-Indian Reservation
03-National Parks	09-Military Reservation
04-National Wildlife Refuge	10-State Park
05-State Wildlife Refuge	11-Wild and Scenic River
06-Designated Critical Habitat	12-National Historic Area

11. Stream Class. At present, two systems of stream class are being used in Oregon, one developed by the State of Oregon, one by the U.S. Forest Service. Indicate the stream class number, and the class system being used. The class systems are:

Oregon

Class 1. Waters which are valuable for domestic use, are important for andgling or other recreation, and/or used by significant numbers of fish for spawning, rearing, or migration routes. Stream flows may be either perennial or intermittent during parts of the year.

Class 11. Any headwater streams or minor drainages that generally have limited or ~~minor drainag~~ or no direct value for angling or ~~oth~~ other recreation. They are used by only a few, if any, fish for spawning or rearing. Their principal value lies in their influence on water quality or quantity downstream in Class 1 waters. Stream flow may be either perennial or intermitten

U.S. Forest Service

Class I. Perennial or intermittent streams or segments thereof that have one or more of the following characteristics: direct source of water for domestic use; used by large numbers of fish for spawning, rearing or migration; flow enough water to have a major influence on water quality of a Class I stream.

Class II. Perennial or intermittent streams or segments thereof that have one or both of the following characteristics: used by moderate though significant numbers of fish for spawning, rearing ~~of~~ or migration; flow enough water to have only a moderate and not clearly identifiable influence on downstream quality of a Class I stream, or have a major influence on a Class II stream.

Class III. All other perennial streams or segments thereof not meeting higher class criteria.

Class IV. All other intermittent streams or segments thereof not meeting higher class criteria.

12. Stream Order. Stream ordering has proven a useful way to categorize streams. The first order stream is one which has no ~~p~~ branches, and is at the upper end of a basin. A second order stream is formed by the union of two or more first order streams. A third order stream results from union of two second order streams, and so forth. Stream order should be assigned on the basis of field observation or the use of aerial photographs. If maps are to be used for stream ordering, a scale of not more than 2" to the mile should be used. With smaller scale, the smaller drainages are lost, so that streams that would be a second, third or even a fourth order stream on a 2":mile map or on the ground become no more than first order streams.

13. Investigator. Indicate name or names of persons conducting the inventory.

14. Date. The date should be given as day-month-year; for the month, either use a three-letter abbreviation or Roman numerals in order to distinguish from day.

15. Time. Indicate time, using the military designation.

16. Comments. Additional comments should be made identifying the inventory reach. A map may be drawn indicating the location and access for the inventory, and placed in the original file. Alternatively, it can be indicated on air photos, maps or overlays.

II. GEOMORPHOLOGY

The geomorphology ~~#~~ information provides data on gradients, landform adjoining the basin, and the potential for erosion and other water-landscape interactions.

1. Major Geomorphic Type. Indicate the dominant geomorphological type in which the inventory reach is located. (Appendix III).

2. Valley Width. Indicate the width of the valley or canyon floor. An average value may be used for the reach. The width of each side may be given separately.

3. Major Geologic Type. Indicate the major geologic type in which the inventory reach is located. The geological type upstream may be indicated if different, and if it has a bearing on the nature of the stream in the inventory reach.

4. Soils. Summarize the major soil types along the inventory reach. If the riparian soils are known and are different from the upland soils, both the riparian and upland soils types should be given. Use the typing of the National Cooperative ~~Survey~~ Soil Survey.

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4. Soils. Summarize the major soil types along the inventory reach. If the riparian soils are known and are different from the upland soils, both the riparian and upland soils types should be given. Use the typing of the National Cooperative Soil Survey.

5. Erosion Potential. Erosion potential is summarized for the uplands of the basin. The channel erosion is covered under a later section. Of concern in conducting aquatic inventories is the source and quantity of sediments passing through or being deposited in the aquatic system. Values can be obtained from other sources, such as the STORET sediment yield values. Also useable are values for total suspended and total dissolved materials in the water. These can be obtained from water quality studies. An erosion model which can be used to predict erosion potential in a basin is the Universal Soil Loss Equation. (Appendix IV). While an indication of erosion potential, the USLE does not provide values for potential sediment yield An estimate of the sediment yield may be obtained from the Sediment Yield Factor Rating (Appendix V). Both of these procedures are well established. Both are based on overland flow of water with resulting erosion and sediment production. In many Oregon areas, principal erosion problems result from mass events such as slope failures and debris torrents. At present no single procedure is available for predicting the number or size of mass events. A recommended approach is to count or estimate the number of such events within a basin or subbasins of a watershed, expressing the value in terms of number per square mile. If possible, the values may be obtained for volume as well as number. The information may be obtained from aerial photographs or from field inventories. For a given basin or area, this value can then be used as a predicter of potential events, and can be expressed in the inventory summary as the size and/or number of events per unit of a basin. Where no information is available on erosion rates, sediment yield, or mass events, an alternative is to have a subjective statement such as that erosion potentials are low, medium or high.

6. Adjoining slopes. Give the percentage slope of adjoining slopes.

7/ Elevation. Indicate the elevation at the beginning of the invnetory reach. If desired, the elevation may also be given at the end of the reach.

8. Gradient. Indicate the stream gradient as an average for the reach, given in decrease in elevation per unit of stream length, or as a percentage f slope as measured within the stream channel.

9. Sinuosity. Indicate stream sinuosity for inventory reach.

10. Basin Area. Indicate the drainage basin area above the inventory reach or for the stream basin., using square miles.

III. STREAM CHARACTER

The stream character is the physical description of a stream channel and its banks, and is concerned with the form of water flow, composition of the channel, and the descriptions of the channel flow patterns.

A. Flow Patterns

The pattern of flow within a stream is seldom uniform, with the pattern influenced by changes in gradient, substrate and other channel characteristics. The following are definitions of specific flow patterns. In an inventory, the percentage of each type of flow pattern would be recorded for the inventory reach.

Pool. An area with little or no current, usually with water deeper than the portions of the stream having a current, and which is useable by fish for resting and cover.

Glide. A shallower area of a stream similar to pools in lack of current, but lacking in depth. Generally not useable for resting or cover, but may be important for rearing and as nursery areas for young fish.

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Run. An area of swiftly flowing water without any surface agitation or waves; surface generally smooth.

Riffle. Flowing water with a low gradient. Surface may be agitated by rocks or gravel, but standing waves are absent.

Rapids. Swift current, with considerable surface agitation, some waves may be present; rocks and boulders exposed at all but high flows. Drops up to three feet.

Use % width

Cascades. Swift current, many exposed rocks and boulders; much surface agitation and standing waves; drops of 3-6 feet common. Where the substrate is smooth bedrock or hardpan, the cascades are a series of drops.

Falls . A continuous drop of more than six feet.

Backwater. Areas, such as side channels, sloughs, or offshots of the main channel, with little or no current, where there is little exc hange with the main channel except during periods of higher flows. Covered by flowing water at high flows. May be much reduced or completely absent at low flows.

B. Channel Characteristics

A number of measurements and descriptions are used to characterize the stream channels. Measurements given are in units of meters or feet, or units of area. The active channel is used for measurements, and is the lower part of the channel entrenchment that is actively involved in transporting water and sediment during the normal flow regime. The reference point for measuring the active channel reach is the point at which the channel banks or the tops of stabilized channel bars abruptly change to a flatter slope. The channel features are relatively permanent and usually vegetated above the active channel. Measurements include the width and depth of the active channel and its sections.

Average Channel Width. A measurement of the active channel at the time of the inventory as an average of measurements for a reach or for each section inventoried in the reach.

Maximum Channel Width. Widest portion of the active channel by reach or section.

Minimum Channel Width. Narrowest portion of the active channel by reach or section.

thalweg width

Maximum Channel Depth. Deepest point in the inventory reach or section.

Average Channel Depth. Average depth of the channel in the inventory reach or section.

Maximum Pool Depth. Depth of deepest pool in the inventory reach or section.

Mean Pool Depth. Mean depth of all pools measured in the inventory reach or section.

Mean Surface Area of Pool. Give the mean values for the surface area of pools, expressed as values for width and length.

Maximum Pool Area. Give the area of the largest pool in the inventory reach or section, expressed as the values for length times width.

Pool Class. Give the percentage of pools in the inventory reach or section in each of the five calsses of pool (Appendix VI).

C. Channel Substrate

The channel substrate is the materials which form the channel, and which influence the other characteristics of the channel.

1. Substrate Composition. The substrate composition is expressed as the percentage of each of the components.
   - Large Boulders - those over one meter in diameter
   - Small boulders - those 30 cm to one meter in diameter
   - Cobbles - rock 15 to 30 cm in diameter

Rubble - rock 7-15 cm in diameter
Large gravel - rock 2-7 cm in diameter
Small gravel - rock 0.25-2 cm in diameter
Sand
Silt
Fines
Clay
Hardpan
Bedrock
Organic debris - small particles of organic matter, including small twigs and branches
Woody Material - tree boles and large limbs

2. Debris Loading. Indicate for the stream reach or section which of the following describes debris loading for the active channel.
   Insufficient - Additional debris loading would be beneficial to pool/cover formation and not be significanlty adverse to other habitat values.
   Balanced - Existing debris loading appears to be balanced with needs for pool/cover but not to the detriment of acceptable stream stability goals.
   Unstable Excess - Debris is excessive and its unstability is or potentially, likely to cause accelerated erosion and other stream damage. Selective removal of some material would be beneficial.
   Loading Potential - Enter whether sufficient large trees or snags are present to contribute future debris loading.

3. Imbeddedness. Imbeddedness is the filling of the interstices of a gravel or rubble stream bottom with sand or fines. Indicate whether the imbeddedness is absent, rare, common, or abundant.

D. Channel and Bank Stability

Channel stability is given through use of the channel stability rating form, outlined in the U.S. Forest Service publication "Stream Reach Inventory and Channel Stability Evaluation", USDA, FS-R-1-75-002. The instructions included in Appendix VII are taken from the original instruction manual; the form is a somewhat modified form used by BLM in which some of the definitions have been rewritten and some of the point totals altered. The values may be reported both as an oral evaluation, as a total points score, or as the point totals for each category plus the total score. The bank stability is summarized by the degree or percentage of unstable banks, according to type of activity, as summarized in Appendix VIII.

IV. WATER BUDGET

The water budget refers to the availability of water, or to the annual cycles of flows in the streams. These flows are dependent upon their source, and on the climatic factors which influence the supply source. Since streams are the channels for movement of water through a drainage system, the water budget represents the basis of the aquatic resource.

A. Annual Flow Cycles

The annual flow cycles indicate the degree of flow during the year.

1. Ephemeral
   Less than one month
   one to three months
   Three to six months

2. Intermittent
3. Perennial

B. Climatic Features.

Indicate the principal climatic features of the immediate basin.

1. Average precipitation, in inches or centimeters.
2. Indicate the principal form in which precipitation falls:
   - Snow
   - Rain
3. Indicate principal season for precipitation
   - Winter
   - Spring
   - Summer
   - Autumn
4. Indicate annual frequency of storm events:
   - 1-5 events
   - 6-10 events
   - Over 10 events
5. Indicate average intensity of storm events:
   - Low
   - Moderate
   - High

C. Water Source

Indicate the principal sources of water for the inventory stream. If more than one major source is involved, so indicate. If known, the values, on an annual basis, for each type of water source may be indicated.

1. Groundwater seepage
2. Precipitation runoff
3. Springs
4. Lake
5. Reservoir
6. Irrigation inflow
7. Other types of discharge (indicate)
8. Snow/ice
9. Basin inflow

D. Water Loss

Indicate the principal losses of water from the inventory stream. If more than one major loss is involved, so indicate. If known, the values, on an annual basis, may be given for each type of water loss.

1. Evaporation
2. Evapotransporation
3. Groundwater recharge
4. Diversions/pumping
5. Basin outflow into:
   - a.River
   - b.Lake
   - c.Reservoir
   - d.Ocean
   - e.Other

E. Flow Levels

Flow levels are used to indicate the range of flows during the year, plus providing a comparison with flows at the time of inventory. When available, values will be from existing gaging stations. If no values are available from gaging stations in the inventory reach or section, values from gaging stations within the basin can be used as appropriate. Flows may also be estimated using the channel geometry method, where appropriate. Values for flows will be given in ft^3/sec or in M^3/sec.

1. Instantaneous flow. Flows will be measured using the water velocity/stream area profile method, summarized in Appendix IX.
2. Indicate maximum flows for:
   a. Instantaneous
   b. Monthly averages
   c. Annual averages
3. Indicate minimum flows for:
   a. Instantaneous
   b. Monthly Averages
   c. Annual Averages
4. Indicate mean flows for:
   a. Instantaneous
   b. Monthly Averages
   c. Annual Averages
5. Indicate recommended minimum flows for the inventory reach or section, on an annual or monthly basis.

V. WATER QUALITY

Water is the compound H_2O. When we refer to water quality, we are not refering to the compound water per se, but to the quantities of materials, compounds and elements dissolved and suspended in the water, in relation to the beneficial uses of the water. In sampling water, the selection of components to be sampled depends upon the particular use or uses of water being considered. Sampling is also done to compare the levels of selected components against established criteria, or allowable limits, which are based on potential and abstract as well as actual uses. With fisheries inventories, the factors limiting fish are usually restricted to a few components, such as temperature or oxygen level. Selection of components will depend upon the needs of the person doing the inventories and the possible limiting factors which may be present. Where possible, the STORET program should be utilized. Sample analysis should utilize techniques described in the current edition of Standard Methods. The following water quality components do not list potential components, but only major categories; actual components to be used will be those included on the STORET program, which can be consulted for greater detail.

A. Temperature

Temperature will be recorded in ^oC or ^oF; indicate which with the recording.

a. Air Temperature:
   - Instantaneous at time of survey
   - Monthly and Annual Mean temperature
   - Monthly and Annual Maximum temperature
   - Monthly and Annual Minimum temperature

b. Water Temperature
   - Instantaneous at time of survey
   - Monthly and Annual Mean temperatures
   - Monthly and Annual Maximum temperatures
   - Monthly and Annual Minimum temperatures

B. Sediments

Sediments in this case refers to the concentration of suspended material in the water. Principal expression is Total Suspended Solids, or TSS, which is expressed in mg/l. When measurements of sediments is not available, values for light passage interference may be used. This includes turbidity, expressed in appropriate units, and the use of a Secchi Disk, with units of visibility.

C. pH

The measurement of pH is a common indicator of the hydrogen ion content.

D. Gases

Gases are given as mg/l. Oxygen is the most commonly measured, but CO_2, chlorine and flourine are among the commonly measured gases.

E. Salts

The measurement of salts includes the measuring of ionic components. Three general values often obtained are Total Dissolved Solids (TDS) and Alkalinity, both given in mg/l, and Conductivity, measured in microohms/cm. Sampling is for individual ions such as sodium, calcium, chloride and sulfate.

F. Nutrients

Since they are the most often limiting, phosphorus and nitrogen compounds are the most often sampled. They are also among the best indicators of excessive nutrients. These and other nutrients sampled are expressed as mg/l.

G. Heavy Metals

While not widely a problem, heavy metals can be important in some areas. Arsenic, lead, iron, mnganese, copper, and other metals are sampled, expressed as mg/l.

H. Organic Chemicals

The fastest growing class of water quality problem components, the organic chemicals include a variety of natural organics such as petroleum products, and many man-made chemicals such as pesticides. More often sampled during a monitoring than a general inventory program, the organics are expressed as mg/l or other appropriate units.

I. Radiation

Radiation is another chemical class more often sampled in monitoring than general inventories. Total alpha and total Beta are the most common components, but other components or chemicals, such as uranium compounds, are sampled. Units mg/l or in radiation units such as rads.

J. Other

Other water quality components may be sampled as needed, and are expressed in appropriate units.

VI. BIOLOGICAL COMPONENTS

In aquatic habitat inventories, vegetation is considered on upland and riparian areas as well as within the stream. These terrestrial vegetation areas influence the stream through control of erosion and sediment production, nutrient levels, run-off rates, and water quality. Knowledge of upland vegetation is also a quick way to characterize the climate of an area. Condition and quantity of vegetation can also indicate human utilization of an area, and aid in understanding the existing condition of a stream.

A. Upslope Vegetation. The upslope vegetation is that vegetation above the riparian zone. The descriptions of the vegetation can be done at a variety of levels from the very site-specific vegetative type to a much wider physiographic region.

1. Regional Vegetative Community. The Kuchler physiographic associations are recommended (Appendix X).
2. Vegetative Types. Where vegetative typing is used for site-specific locations, the types associated with the upslope vegetation along the inventory section or reach will be listed.
3. Species Composition. If vegetative typing is not available, indicate the principal species present.
4. Cover. Indicate the cover by percentage; may be broken down into cover by species or major plant groups.
5. Vegetative Condition. Indicate vegetative condition in terms of the potential for the site. The condition may be expressed as a percentage or in other appropriate units. A general indication may be made by the following subjective categories:
    - Excellent: 80-100% of potential
    - Good:60-80% of potential
    - Fair:40-60% of potential
    - Poor: Less than 40% of potential
6. Vegetative Trend: Indicate vegetative trend as:
    - Stable
    - Up
    - Down

B. Riparian Vegetation. Riparian areas are those terrestrial areas where the vegetation complex and microclimate conditions are products of the combined presence and influence of perennial and/or intermittent water, the associated high water tables and soils which exhibit some wetness characteristics. Riparian areas may be covered in other vegetative inventories as a vegetative type; more often, information must be taken during aquatic or special riparian inventories. The recommended procedure is the step transect method (Appendix XI).

1. Species Composition. Indicate major vegetative species, both existing and potential:
    - Trees
    - Shrubs
    - Forbs
    - Grasses
2. Age Class
3. Cover: Indicate the percentage cover. This may be broken into % cover for:
    - Trees
    - Shrubs
    - Forbs
    - Grasses
4. Vegetative Condition: Indicate current condition in terms of potential for the site. A general indication may be given by the following subjective categories:
    - Excellent: 80%-100% of potential
    - Good: 60-80% of potential
    - Fair: 40-60% of potential
    - Poor: Less than 40% of potential
5. Vegetative Trend: Indicate vegetative trend as:
    - Stable
    - Declining
    - Improving

6. Width of Riparian Zone: Indicate the maximum, minimum and mean widths of the riparian zone for both left and right side of stream for each inventory section or reach.
7. Shade: Indicate the percentage of stream shaded during the period of 10 a.m. and 5 p.m. for each inventory section or reach.

C. Aquatic Vegetation. Aquatic vegetation is that vegetation in, on or under the water, and which requires surface water for its existence.

1. Type: Indicate the type of aquatic vegetation present, giving the name and whether emergent, submergent, planktonic or algae.
2. Abundance: Indicate the abundance of each type of vegetation. If seasonal, indicate the principal season for both the maximum and minimum levels of vegetation. If distribtuion is irregular, indicate distribution pattern for each stream reach or section.

D. Coliform. Coliform samples are often taken as an indicator of water quality, nutrient levels, and the presence of wastes from warmblooded animals. Samples should be analyzed through a certified laboratory. Results may be reported from uncertified labs and from field analysis kits such as those developed by Millipore. Coliform are given as total, fecal, strep, or other categories, with total and fecal E. coli being the most often reported. Results should be in MPN, or, Most Probable Number, for sample size of 100 ml.

E. Macroinvertebrates. Macroinvertebrate samples may be collected using one of the approved techniques such as Surber samplers, instream baskets, drift nets, etc. Selection of sample sites and frequency of sampling will depend upon inventory needs.

1. Species Present: Indicate species present, numbers per species, and tolerance levels per species, per unit of area sampled.
2. Species Diversity. Indicate the species diversity, such as the Shannon-Wiener or Sequential Comparison Index. Indicate the measure used and units of area covered.
3. Biomass. Indicate total biomass per unit area.

F. Fish Species. Information may be collected by any standard collection procedure, expressed in appropriate units.

1. Species Composition. Indicate species present using common or scientific names, or a recognized coding system.
2. Origins. Indicate by percentage whether hatchery or natural production.
3. Age. Age of the fish can be shown as age class, or through use of the following designations:

E-egg	A-alevin	S-smoth	F= FRY
L-larvae	J-juvenile	M-adult	G=FINGERLING

4. Species Abundance. Indicate the relative abundance of each species, in numbers or population percentage, using the codes in Appendix XII.
5. Species Population Trends. Indicate for each species the population trend using the following codes:

+ = Population increasing	I=Species Introduced
0 = Population stable	H=Population exceeds historic levels
- = Population decreasing	B=Populatin below historic levels
K = Population trend unknown	

6. Fish Use. Indicate fish use by species for the inventory reach or section. More than one letter may apply for each species. If use is seasonal, indicate season of use. Use codes in Appendix XIII.

6. Width of Riparian Zone: Indicate the maximum, minimum and mean widths of the riparian zone for both left and right side of stream for each inventory section or reach.
7. Shade: Indicate the percentage of stream shaded during the period of 10 a.m. and 2 p.m. for each inventory section or reach.

C. Aquatic Vegetation. Aquatic vegetation is that vegetation in, on or under the water, and which requires surface water for its existence.

1. Type: Indicate the type of aquatic vegetation present, giving the name and whether emergent, submergent, planktonic or algae.
2. Abundance: Indicate the abundance of each type of vegetation. If seasonal, indicate the principal season for both the maximum and minimum levels of vegetation. If distribution is irregular, indicate distribution pattern for each stream reach or section.

D. Coliform. Coliform samples are often taken as an indicator of water quality, nutrient levels, and the presence of wastes from warmblooded animals. Samples should be analyzed through a certified laboratory. Results may be reported from uncertified labs and from field analysis kits such as those developed by Millipore. Coliform are given as total, fecal, strep, or other categories, with total and fecal E. coli being the most often reported. Results should be in MPN, or, Most Probable Number, for sample size of 100 ml.

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3. Biomass: Indicate total biomass per unit area.

F. Fish Species: Information may be collected by any standard collection procedure, expressed in appropriate units.

1. Species Composition. Indicate species present using common or scientific names, or a recognized coding system.
2. Origin. Indicate by percentage whether hatchery or natural production.
3. Age. Age of the fish can be shown as age class, or through use of the following designations:

E-egg	A-alevin	S-smolt	Y-YOY
L-larvae	J-juvenile	M-adult	G-[illegible]

4. Species Abundance. Indicate the relative abundance of each species, in numbers or population percentage, using the codes in Appendix XII.
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X = Population trend unknown	

6. Fish Use: Indicate fish use by species for the inventory reach or section. More than one letter may apply for each species. If use is seasonal, indicate season of use. Use codes in Appendix XIII.

G Standing Crop The standing crop is a measurement of the size and number of fish present in a population, by species and in the aggregate.

1. Population Size. Indicate the number of fish by species or in aggregate for a given unit of habitat. Units of habitat most useable are surface area or volume.
2. Biomass Indicate biomass by speciess or in aggregate in kg per unit of habitat
3. Indicate the length distribution and weight of individual specimens The condition factor may be calculated by using the formula length:weight to give the relationship used as condition factor.
4. Age Class Distribution can be determined in many stocks using the length frequency distribution with the year classes delimited by the peaks of the length frequency histogram

   A second method is the examination of scales circuli or other hard substances which can give annual or seasonal growth ringss that can provide the age of the fish Summation by year class for a species will provide the species age distribution

H Stocking. For the inventory section sum marize the stocking history It may be necessary to extend the summary to stocking sites outside the actual study area in order to bring into consideration stocked populations that are found in the inventory section. For each section indicate:

1. Species stocked Refer to species code in Sppendix .
2. Dates of stocking
3. Numbers and age class of stocked fish
4. Location of stocking Use stream reach code for stocking site. May use landmark reference
5. Size of stocked fish

   For age class or size of fish, the following may be used:

   a. Number of fish per unit of weight
   b. E=egg
      L=larvae
      A-alevin
      F-fry
      J-juvenile/fingerling
      S-smolt
      A-adult

I Habitat Problems In addition to the characteristics of fish habitat covered by the individual habitat components there are a number of problem situations that arise that are not directly described by other inventory components Those identified in inventory procedures include:

1. Barriers Indicate if barriers block migrations of fish Indicate the type of barriers
   a Waterfall
   b Dam
   c Log jam
   d Culvert or bridge
   e velocity barrier
   f water quality barrier
2. Low nutrients Indicate limiting factor
3. Ice. Indicate if:
   a Anchor ice
   Ice scour
   c Surface ice cover
4. Excessive flow fluctuation: low flow inadequate or high flow commonly excessive for channel characteristics and fish habitat May be due to manmade or natural causes.

G Standing Crop. The standing crop is a measurement of the size and number of fish present in a population, by species and in the aggregate.

1. Population Size. Indicate the number of fish, by species or in aggregate for a given unit of habitat. Units of habitat most useable are surface area or volume.
2. Biomass. Indicate biomass by species or in aggregate, in kg per unit of habitat.
3. Indicate the length distribution and weight of individual specimens. The condition factor may be calculated by using the formula length:weight to give the relationship used as condition factor.
4. Age Class Distribution can be determined in many stocks using the length frequency distribution, with the year classes delimited by the peaks of the length frequency histogram.

   A second method is the examination of scales, otolith, or other hard substances which can give annual or seasonal growth rings that can provide the age of the fish. Summation by year class for a species will provide the species age distribution.

H Stocking. For the inventory section, one review the stocking history. It may be necessary to extend the account to stocking sites outside the actual study area in order to bring into consideration stocked populations that are found in the inventory section. For each section indicate:

1. Species stocked. Refer to species code in Appendix.
2. Dates of stocking.
3. Numbers and age class of stocked fish.
4. Location of stocking. Use stream reach code for stocking site, key use landmark reference.
5. Size of stocked fish.

   For age class or size of fish, the following may be used:

   a Number of fish per unit of weight
   b. Eggs
      1-Larvae
      2-Adults
      3-Fry
      3-Juvenile/Fingerling
      5-small
      6-adult

I Habitat Problems. In addition to the characteristics of fish habitat covered by the individual habitat components, there are a number of problem situations that arise that are not directly described by other inventory components. Those identified in inventory procedures include:

1. Barriers. Indicate if barriers block migrations of fish. Indicate the type of barriers:
   a. Waterfall
   b. Dam
   c Log jam
   d Culvert or bridge
   e velocity barrier
   f water quality barrier
2. Low nutrients. Indicate limiting factor
3. Ice. Indicate if:
   a Anchor ice
   Ice scour
   c Surface ice cover
4. Excessive flow fluctuation. Low flow inadequate or high flow commonly excessive for channel characteristics and fish habitat. May be due to manmade or natural causes

5 Bedload movement Excessive movement of bottom material resulting in unstable substrate for invertebrates and filling or shifting of pools

6 Highly erosive drainage: Soils of drainage are highly unstable and erosive, and readily erode or slide with removal of vegetation or disturbance.

7. Lack of streamside cover: Becasse of unstable banks or because of bread deposition stream channel not well confined with steep adjoining stabl banks that can be used for cover

8 Bow aquatic invertebrate populations: Low aquatic invertebrate production resulting in reduced potential fish food supply

9. Lack of riaprian vegetatin: Inadequate riparian vegetation to provide for shading, bank protection, food sources and stream structure.

10 Overharvest of fish: Fish harvest exceeds the optimum sustainable levels ### or is below the levels needed to maintain populations.

11 Excessive temperatures: Excessive high temperatures as a result of natural or man-caused reductions in shading and flow

12 Organic pollution: Excessive nutrients entering stream resulting in loss of oxygen and over-abundance of algae and moss.

13 Exessive reduction in temperaures: Reduction of temperatures below those needed for reprodcution or survival whether due to natural or man=caused changes in water temperatures entering the system or changes in flows and streamside vegetation.

14 Irrigation return or run-off: Irrigation returns or over surface runoff that significantly increases the water temperature salts sediments etc

15 Unprotected withdrawals Withdrawals for irrigation industry power generation or other uses inadequately protected resulting in damage or loss of fish

16 Saline water: Dissolved materials in water excessive as a result of natural or man-caused conditions

17 Toxic waters: Water contains toxic chemicals either arising from natural formations or man-caused pollution

J Special Use Areas Indicate areas which require special consideration either because of withdrawals or importance to maintenance of fish populations

1 Designated withdrawals
   a Designated critical habitat for T/E species
   b Habitat described as crucial habitat for a sensitive species
   c. ACEC
   d Wild and Scenic River
   e Other

2. Spawning Habitat Indicate:
   a. Species
   b Location of habitat
   c. Type of habitat (i.e., spawning gravel nesting area)
   d Quantity or area of spawning habitat
   e Season of use

3. Rearing nursery areas
   a Species
   b Location
   c Type of habitat
   d Season of use
   e. Quantity or area of rearing habitat
   f Condition

4. Cover. Indicate the presence of subsurface cover: including abundance and distributional patterns (APPENDIX XIV)

K Other Animals Indicate species of observed animals using the BLM Species Code

1 Amphibians
2 Reptiles
3 Birds
4. Mammals
5. Beaver. Indicate the following information for each beaver dam or hole
   Location
   Size of pool
   Height of dam
6 Indicate existence in or adjoining of designated critical habitat for other than aquatic species, indicating species. Also indicate if a recovery plan has been developed that includes the aquatic habitat

VII. HUMAN ACTIVITY

A ACCESS Indicate the easiest method of travel (access) that can be used to reach the stream being inventoried. Access is being defined as reaching to within 100 meters of the stream. If more than one type of access is possible more than one can be indicated Indicate any restrictions on access. If there is a designated trail or road access these can be indicated. A map may be included demonstrating the method of access

1 Method of Access

A-passenger auto	W on foot
J-4x4 vehicle	F float boat
M motor bike	B-power boat
H-horse	P-fixed wing aircraft
C helicopter	

2 Access Route - indicate name or number

R-road	W-water
T-trail	A-air
N-no improved access	N-route or trail name or number

3 Restrictions on access

A-no restrictions	C-permit required
B-no pubic access	D-fee charged

B INGRESS Ingress refers to the legal right to enter onto a stream reach The following codes may be used to indicate the type of ingress

1- Stream section bordered almost entirely by public lands with assured public access
2- A stream section bordered by a mix of private and public land where the public land is distributed in such a way that no significant portion of the stream is unavailable by vehicle and/or walking. Floating may also be a major means of access.
3. A stream section bordered by mostly private land where ingress is uncontrolled or readily available by permission. This portion may be available by floating or through navigability laws
4. A stream section bordered mostly by private land where ingress is limited but some fishing is allowed. May include minor portions where public land or road crossing may provide limited ingress The portion through private land may legally be available by floating or through navigability laws
5 A stream section bordered entirely by private land where public fishing is available for a fee or where a small group has leased exclusive rights Legality may be in question on some streams but this category identifies the current fee or lease fishing areas Access through the section may be possible by floating and naviabiltiy laws but use of shore is restricted

7. A stream or stream segment bordered by public land that is unavailable because of posting on private land or locked gates on private roads

C ESTHETICS Indicate features that contribute or detract from the esthetics of the stream Indicate the rating for esthetics

1 Esthetics rating

A-water of outstanding natural beauty in a pristine setting

B-water of value comparable to A except that it may lack pristine characteristics Presence of human development such as roads farms and buildings compromise the difference between A and B

C-A water with natural beauty but of a more common type that A or B A clean stream in an attractive setting

D A stream within a setting of fair esthetic qualities: either the stream or its setting has reduced esthetic qualities

E-A stream with low esthetic qualities or one in an area of low esthetic values such as in an urban setting

2 Esthetic problems Indicate which of any esthetic detractors are found in the stream section

A-pollution
B-dewatering
C-removal of streamside vegetation
D-channelization
E-riprap especially old car bodies discarded materials
F-mine tailings
G HIGHWAYS adjoining stream or other major travel routes
H-urbanization
I-severe land abuse

D SPECIAL VALUES Indicate speciel values for the inventory reach

1 Major brood stock area
2. Major harvesting area commercial or sport fishing
3 Area managed for downstream water quality or quantity.
4 Major recreation or scenic area
5. Area has local community social or political importance
6 Other

E OTHER RESOURCE USES Indicate the historic or current uses of a stream reach or of upstream areas that influence the quality of fish habitat in the inventory reach For each use indicate the degree of use the extent of the impact on the fish habitat and whether the impact is short-term or long term. For each of the indicated resources:

S short-term impact L Long-term impact

Use is:

1 - seasonal (F-fall W winter P spring U-summer)
2 - occasional
3 - frequent
4- continuous

Impacts are:

1 light
2 medium
3-heavy
4 - destructive

1. Water withdrawals: Indicate point of withdrawal and purpose

a. Location
b Purpose

L-livestock	D-domestic use	I- industrial use
R- recreation	M - mining	A-agricultural
P- power	o - other	

2 Livestock Indicate the species using the area season of use level of use and any special management
   a Species
      H-horse C-cattle S-sheep O-other
   b Season of Use
      P-spring U-summer F-fall W-winter
   c. Grazing System
      Allotment Management Plan or other Grazing Plan operational
      S-seasonal Use R-rotational use RR-rest-rotation system
      CC-cow-calf operation O-other
3. Domestic Use Indicate domestic use of aquatic areas adjoining slopes and withdrawals for domestic use. Indicate:
   a Location of use
   b Amount of water
   c. Water right code
4. Industry: Indicate industrial development along inventory reach and types of impact upon the stream Indicate:
   a-withdrawals . location and amount
   b discharges. location and amount
   c. Materials entering stream system
   d. Modification of channel
   e- Other
5 Recreation: Indicate types of recreational use location of use seasonal variability of use and level of use
   a Season of use
      P spring U summer F fall W-winter
   b Use levels in visitor-days
   c Type of use
      S swimming B-boating N scenic F-fishing
      H- hunting P-picnic C-camping O-other
6 Mining Indicate mining activity in stream system and the type and degree of impact
   a location
   b Product
   c tailings location
   d discharge
7 Road Construction Indicate the presence of road or crossing construction within inventory section or upstream where influence is felt in inventory section
8 Dredging. Indicate any dredging operations either one-time or regular channel maintenance include timing and location
9 Channel alterations Indicate other channel alterations such as changing channels or channelizing streams which have occured in the inventory reach Indicate nature of change
   R-channel relocation S- channel straightening
   C-channelization T- channel constriction
   V- vegetation removal P-channel riprap
10. Agriculture. Indicate agricultural activity along the inventory reach or upstream if it impacts quality of habitat in inventory reach Indicate major type of agricultural activity
11 Dams Indicate the location of dams including the following information Reservoirs will be treated under the standing water inventories
   a location d Discharge
   b Size of dam e. Storage capacity
   c Principal purposes f Indicate if barrier or laddered
12 Habitat Projects: Indicate any aquatic habitat improvement projects that have been undertaken in the inventory reach

F HARVESTING AND OTHER USE OF FISH. Discuss the extent and type of utilization of the fish or other aquatic organisms for the inventory area Indicate the type of utilization and the degree of utilization by species

1 Species Indicate the species using the species code

2 Type of Use Indicate the use of each species.

a- sport	c-research	e-visual/esthetics
b - commercial	d- scientific	

3 Harvest Methods Indicate the methods used to harvest or otherwise sample fish populations

a-electroshock	g-hook and line	m-beach seine
b-video	h-gill net	n-hand seine
c-visual	i-dip net	o-fish wheel
d-troll	j-trammel net	p-explosives
e-trawl	k-chemicals	q-pots
f-purse seine	l-fish trap	r-longlines

4 Harvest levels Summarize the yields by species and type of harvest
a-number of fish
pounds of fish
c-catch per unit of effort (specify)
d-fish/day
e-recreation/days
f-catch per person
g-total harvest

VIII MANAGEMENT OPPORTUNITIES AND NEEDS

Indicate which of the following opportunities for improvement of aquatic habitat is found in the inventory area Problems and their location will be identified in other parts of the inventory

1 Survey or study needed Additional inventory information or more intensive information is required for developing management plans
2 Pollution Control Pollution control needs to be implemented to reduce or eliminate conditions in the stream that reduce the quality of habitat
3 Flow Alleviate or reduce problems associated with reduced flows Minimum flow levels need to be established by stream and season of use The recommendations may relate to reducing loss of flow or augmenting existing flows
4 Irrigation Improvement If poor irrigation practices such as excessive water removal excessive sedimentation or chemical pollution excessive channel disruptiong are occuring discuss needs and options to reduce or eliminate the problem
5 Erosion Control Includes bank erosion sheet and rill erosion head cutting land slides and slumps and other forms of erosion either natural or man-caused.
6 Riparian vegetation Includes enhancing and maintaining riparian vegetation sufficient to provide bank stability shaxe and enhancement of instream habitat diversity
7. Fencing Indicate streambank and riparian fencing needed by distance and location
8 Watershed Protection. Management opportunities for the watershed to protect and improve water quality ahd hydrology for the benefit of aquatic habitat Includes protection and imrpovement in vegetative cover and stabilization of soils

E. HARVESTING AND OTHER USE OF FISH. Discuss the extent and type of utilization of the fish or other aquatic organisms for the inventory area. Indicate the type of utilization and the degree of utilization by species.

1. Species: Indicate the species using the species code.

2. Type of Use: Indicate the use of each species:
   a - sport
   b - commercial
   c-research
   d- scientific
   e-visual/esthetics

3. Harvest Methods: Indicate the methods used to harvest or otherwise sample fish populations:

a-electroshock	g-hook and line	m-beach seine
b-video	h-gill net	n-Hand seine
c-visual	i-dip net	o-fish wheel
d-trail	j-trammel net	p-explosives
e-fyke?	k-chemicals	q-rotenone
f-purse seine	l-fish trap	r-longlines

4. Harvest levels: Summarize the yields by species and type of harvest:
   a-number of fish
   b-pounds of fish
   c-catch per unit of effort (specify)
   d-fish/day
   e-recreation/days
   f-catch per person
   g-total harvest

VIII. MANAGEMENT OPPORTUNITIES AND NEEDS
Indicate which of the following opportunities for improvement of aquatic habitat is found in the inventory area. Problems and their location will be identified in other parts of the inventory.

1. Survey or study needed: Additional inventory information or more intensive information is required for developing management plans.
2. Pollution Control: Pollution control needs to be implemented to reduce or eliminate conditions in the stream that reduce the quality of habitat.
3. Flow: Alleviate or reduce problems associated with reduced flows. Minimum flow levels need to be established by stream and season of use. The recommendations may relate to reducing loss of flow or augmenting existing flows.
4. Irrigation Improvement: If poor irrigation practices, such as excessive water removal, excessive sedimentation or chemical pollution, excessive channel disruptions, are occurring, discuss needs and methods to reduce or eliminate the problem.
5. Erosion Control: Includes bank erosion, sheet and rill erosion, head cutting, land slides and slumps, and other forms of erosion, either natural or man caused.
6. Riparian vegetation: Includes enhancing and maintaining riparian vegetation sufficient to provide bank stability, shade, and enhancement of instream habitat diversity.
7. Fencing: Indicate streambank and riparian fencing needed by distance and location.
8. Watershed Protection: Management opportunities for the watershed to protect and improve water quality and hydrology for the benefit of aquatic habitat. Includes protection and improvement in vegetative cover, and stabilization of soils.

9. Bank Stability In addition to protection or improvement of bank stability for erosion control includes also protection from mechanical disturbance and disruption
10. Barrier Removal Includes removal of blocks to fish movements both natural and man-made, that retard upstream and downstream migrations
11. Beaver Control Management of beavers to provide for beaver=created habitat but to also include removal where activities damage the riparian vegetation or create fish blockages.
12. Fish Species Management Changes in species composition or abundance needed include such actions as introduction of new species changes in current planting practices removal of undesireable species or the initiation of a stocking program
13. Changes in Regulations and Laws Includes making recommendations for changes in regulations such as season of harvest or catch limits in order to maintain populations
14. Enforce Regulations Additional emphasis needed on enforcement of existing regulations
15. Improve Channel Improvements needed to stabilize a channel or to improve the configuration to improve habitat or reduce erosion or other problems This can include rechannelization riprap inchannel structures or removal of disruptive materials
16. Improve Spawning Improve the spawning potential through improvement or increase in the amount and quality of available spawning habitat
17. Remove Debris Removal from the channel and bank area debris which is causing blockage to fish movements or is contributing to erosion problems
18. Change Access Increase or decrease public ingress in order to management both habitat and fish populations
19. Reduce Recreational Use Includes a reduction in non-fishery recreational use of the aquatic and riparian areas to ptotect vegetation water quality and fish habitat
20. Improve Cover. Provide additional instream and streamside cover and habitat diversity through addition of structure streamside vegetation and pool
21. Improve Rearing Area. Improve rearing areas through creation of quiet offstream habitat, pool area and cover needed by young fish.
22. Parasites and Diseases Reduce infections of parasites and diseases through control of water quality, use of resistant fish strains and the direct control of parasites and intermediate hosts
23. Population Balance. Control population balance through removal of excess or undesireable species control total populations to reduce stunting and control the balance of predator and prey species

B. STANDING WATER

Standing waters are those non-marine waters not covered as streams or rivers. They include reservoirs and lakes, plus smaller waters such as ponds, springs and seeps They may be found in conjunction with flowing water, such as reservoirs· in this case, they are considered under standing waters and not as part of the river system. The separation is based upon the type of habitat and the processes that affect it

I. IDENTIFICATION

Information collected in this categorv serves to identify the water being inventories the portion of the water covered by the inventory its location personnel involved and other administrative information. Explanations are the same as those given under Flowing Water unless otherwise described.

1 Water Name

2 Basin

3 Type of Water Body
- G-Seep or spring
- D- pond· a water body formed and altered in water level by man· under 20 acres in normal surface area.
- R-Reservoir. A water body formed and altered in water level by man over 20 acres in normal surface area.
- N - natural lake supplemented by man-made structure
- C- Cirque lake. Formed in rock cirque basin by plugging action of the head of a former glacier
- P - Paternoster Lake. Rock basin scoured out by a glacier as it moved downhill (not a Cirque or Moraine Lake).
- T- Moraine Lake Formed bhind terminal or lateral debris dam left by glacier.
- K - Kettle. Pothole or Bog Lake. Small depression, normally less than 10 acres usually formed by melted ice block left from glacier activity.
- V-Crater Lake. Natural collection of water in a crater or caldera of extinct or inactive volcanoe.
- E - Lake formed by crustal movement of earth: upwarping of earth's crust which forms a dam or downwarping which forms a depression
- S - Lake formed by a slump or sinkhole
- L - Lake formed by a landslide or lava flow.
- O - Oxbow Lake. Formed by a streambed meander cut off from the main channel
- U- Solution Lake. Formed by either dissolution of substrate or formation of lake sides by deposition of mineral deposits
- M-Manmade Lakes
- Y- Playa Ephemeral lake in the floor of isolated basins
- A- Permanent lake formed by accumulation of water in the bottom of a depression
- B- DUNE LAKE. Formed by -

4 Administrative Code

5 Coordination

6 Counties

7 Ownership

8 Administrative Unit

9 Special Designation Areas

10 Sample Sites of Stations For each sample site or station indicate:
a-Site or Station number or code designation
b-Location based on coordinates or other standard relationships

11 Investigators

12 Date of Inventory

13 Time

14. Comments

III GEOMORPHOLOGY
Descriptions are the same as those for Flowing Water unless otherwise indicated.

1. Major Geomorphic Type

2. Valley Width

3. Major Geologic Type

4. Soils

5 Erosion Potential

6 Surrounding Terrain

7. Elevation

IV. FORM CHARACTERISTICS

1 Flow Control Structures Indicate the presence of a dam or other flow control structure that contributes to the formation of the water body being inventories
a-Type of structure
E-earthfill dam B-beaver dam
C-concrete dam D-diversion dam
W-wooden dam
b-Height of structure
c-Length of structure
d-Flow control and release gates or apparatus: present or absent

2. Surface Area
Maximum
Minimum
Mean
Averate

3. Depth Profile.
Maximum
Average
Mean
Average annual fluctuation
Percentage of water body that is:

0-10 ft	10-20 ft	20-30 ft	30-40 ft	40-50ft	50-60 ft
60-70 ft	70-80ft	80-90ft	90-100ft	100-200ft	over 200 ft

4. Volume. Volume of the water body should be referenced to the surface area and maximum depth at the time the volume is calculated More than one volume measurement may be given If so indicate the measurements in relationship to:

Maximum volume
Average volume
Minimum volume

Volume may be estimated using the formula:

$$\sum \frac{A_1+A_2}{2} \times D(A_1-A_2)$$

Where A_1 is the area at depth 1, A_2 is the area at depth 2, and D is the depth or distance between A_1 and A_2 An average volume is then calculated for each layer of water between surface and bottom, at prescribed depth intervals: by summing the individual calculations, a total volume can be estimated.

5. Shoreline Development. The shoreline development can be estimated using the formula:

$$SD = \frac{S}{2\sqrt{\pi A}}$$

where S is the length of the shoreline, and A is the surface area of the water body If more than one calculation is made they should be are the maximum mean and minimum water levels

Maximum
Minimum
Mean

6. Wetted Perimeter. For springs and seeps where there is no body of standing water indicate the area of the associated wetted perimeter

7 Substrate See Flowing Water

8. Mixing

a-Stratification
PResent
Absent

b Thermocline:
Present Absent
Depth:
Top
Bottom
Season thermocline is present:
P-springs U-summer W-winter F-fall
Season when overturning and mixing present:
P-spring U-summer W-winter F-fall

c. Chemocline
Present Absent
Depth
Top Bottom

d. Location
Throughout water body
Only in depper portions of water body
Plumes present
Localized areas only
Surface
Midwater
Bottom

(VI) WATER BUDGET

A. Seasonal Fluctuations. Indicate the degree and timing of seasonal or annual changes in water levels, and of inflow or outflow of water.

1. Perennial
2. Ephemeral
   - Less than one month per year
   - One to three months per year
   - Three to six months per year
   - Over six months per year

B. Climatic Features: See flowing water

C. Water Source
Indicate the principal sources of water for the water body. If more than one major source is involved so indicate. If known the values on an annual basis for each type of water source may be indicated
1. Volume of inflow on an annual basis
2. Volume of inflow average instantaneous level
3. Groundwater seepage
4. Presipitation runoff
5. Springs
6. Irrigation inflow
7. Other types of discharge (indicate)
8. Snow/ice
9. Basin inflow, surface

D. Water Loss
Indicate the principal losses of water from the inventory system. If more than one major loss is involved, so indicate. If known the values on an annual basis may be given for each type of loss
1. Volume of outflow, on an annual basis
2. Volume of outflow, on an average instantaneous basis
3. Evaporation
4. Evapotranspiration
5. Groundwater recharge
6. Diversions/pumping
7. Outflow into:
   - a-river
   - b-ocean
   - c-other
   - d.reservoir
   - e-lake

E. Reservations
Indicate existing or needed water reservations including amounts needed season needed and purpose of reservation
1. Water reservation:
   In Place   Needed   Not Needed   Not in Place
2. If present indicate water reservation
   - a-Amount
   - b-Time needed
     - Season: P-spring   U summer   F-fall   W-winter
     - Month: Months(s) of reservation may be indicated use a numerical code for the month (0-12)
   - c Purpose
     - Recreation   Fisheries   Irrigation   Power reserve
     - Aesthetic   Domestic   Other

V. WATER QUALITY
See Flowing Water discussion

VI BIOLOGICAL COMPONENTS
Most components are the same for standing water as for flowing water The definitions and catageories may be obtained from the flowing water section unless otheriwse indicated.

A Upslope Vegetation

B Riparian Vegetation

C Aquatic Vegetation

1 Type Give species of vegetation present and for each indicate the type

Emergent	Planktonic
Submergent	Algae
Rooted	
Pelagic	

2. Abundance Indicate for each type

Common	Widespread	Shallow Water
Abundant	Localized	Deep water
Rare	Onshore	

3. Seasonality . Indicate for each type
Perennial
Seasonal
P-spring U-summer F-fall W-winter
Annual blooms
Present Absent

D. Trophic Level Indicate the general classification of the water body:
O-Oligotrophic: nutrient poor, oxygen rich, depth usually exceeds 25ft bottom type of organic matter mainly absent Dissolved oxygen plentiful to bottom, emergent vegetation absent or scarce total dissolved solids less than 30 mg/1 plankton scarce visibility high
M-Mesotrophic Lake: Attributes are intermediate between those for oligotrophi and eutrophic lakes Depths usually greater than 20 ft
E-Eutrophic lake: usually 10-25 feet deep Bottom type has much organic matter present The dissolved oxygen decreases with depth and is often absent in bottom water Emergent aquatic plants are present and the total dissolved solids is greater than 30 mg/1 Plankton abundant
D-Dystrophic Lake: Depth is less than 20 feet Lake is characterized by incomplete decay of plants accumulation of humic materials This includes bog lakes The bottom type is entirely organic The lake is saturated during daylight hours with dissolved oxygen which generally drops to below saturation at night Emergent aquatic plants are abundant Plankton abundant

E Coliform - See Flowing Water

F. Invertebrates. Indicate the population, location and seasonal fluctuations of the invertebrate populations

1 Plankton
Species
Season
P-spring U-summer -W-winter F-fall R-perennial
Seasonal bloom
Present Absent

Abundance By species
Abundant
Common
Rare
Biomass, per unit of habitat
By species
Total
Water level of population by species
Surface Midwater Bottom water layers
2. Benthic Organisms
Species present
Biomass/unit of habitat
Location
Onshore
shallow water
deep water
Diversity Index

Remaining items as in Flowing Water

VII HUMAN ACTIVITIES
Use Flowing Water discussions, changing from flowing to standing water

VIII MANAGEMENT OPPORTUNITIES AND NEEDS
Indicate which of t'e following opportunities for improvement of aquatic habitat is found in the inventory area Problems and their location will be identified in other parts of the inventory Most of the definitions are the same as for flowing water· the definition is not repeated. Only those that differ from the flowing water definitions are spelled out

1 Survey or study needed
2 Pollution control
3 Water Levels Management opportunities need to be identified and implemented to maintain water levels to meet fish requirements. This is especially important during spawning and rearing areas when fish are most vulnerable to fluctuation water levels· and during periods of peak stress such as late summer or deep freezing periods. This includes also operation of releases to provide for spawning rearing and habitat requirements of fish in flowing water below a dam.
4. Irrigation Improvement
5 Erosion Control
6 Riparian Vegetation
7. Fencing
8 Watershed Protection
9 Bank Stability
10 Mixing. Increase the season or rate of mixing through changes in inflow and outflow, or through operation of mechanical devices such as aerators
11. Increase Shoal Area. Where insufficient shoal areas are available for spawning, food production or shelter, add shoal areas through excavations, filling or other methods.
12 Fish Species Management
13. Changes in Regulations and Laws
14. Enforce Regulations
15. Improve Nutrient Levels. Reduce influx of unneeded or undesireable organic matter or nutrients· reduce production and dposition of excess organic matter. Where limited nutrients may be added to increase the productivity

16 Improve Spawning Habitat
17. Minimum Pool Develop management recommendations for retention of a minimum pool.
18 Change Access
19. Reduce Recreational Use
20 Improve Cover
21 Improve Rearing Area
22. Parasites and Diseases
23. Population Balance
24. Operate System for temperature and oxygen Through inflow or outflow regulation seek to maintain oxygen and temperature levels in the water body suitable for fish habitat This would include also the temperature and oxygen in water released downstream
25 Migrating Fish Protect and provide for upstream and downstream migration of fish

APPENDIX III
MAJOR GEOMORPHIC LANDFORM TYPE

01-coastal delta
02-lake delta
03-swamp-bog-marsh
04-flatt alluvial valley
05-flat plains
06-rolling hills
07-upland plateau
08-low bluffs
09-broken badlands
10-U-shaped valley
11- V-shaped valley
12- steep hillsides
13- high cliffs
14-steep ##### alpine

APPENDIX IV
UNIVERSAL SOIL LOSS EQUATION (USLE)

The USLE is an expression of the averal annual erosion rate, and is found by the equation:

$$A=RKLSCP$$

A - average annual erosion rate in tons/acre/year
R - rainfall runoff factor
K - soil erodibility factor
LS- topographic factor
C - cover management factor
P - support practice factor

Erosion Rate, A. The value of A is designed to predict the longtime average soil losses in runoff from a specific area. It has been used to predict soil loss on a short-term basis, but is a better index of soil loss for an average of conditions.

Rainfall and Runoff Factor, R. The erosive action of storm events is influenced by the intensity of rain and its duration. The Factor R in the soil loss equation quantifies the raindrop impact effect and provides relative information on the amount and rate of runoff likely to be associated with rain. ~~F~~ Values for Oregon and Washington are in following figures 1&2

In some areas, such as the rolling wheat country of eastern Oregon and Washington, the rate of runoff is altered by ground ~~free~~ freezing, ground surface thawing and snow melt. In these types of areas, the R value is replaced by another value, Rt:

$$Rt = R + Rs$$

Rt is the total R value used in the USLE. R is taken from the figures ~~that follow~~ 1&2. Rs is found by multiplying the local December through March precipitation times 1.5 For example, if the R value for Pendelton was 20, and the average preckpitation between December 1 and March 31 was 12 inches, then Rt=20+12(1.5) = 38.

Soil Erodibility Factor, K. Soil erodibility is an inherent characteristic of a soil, and is an indication of susceptibility of a soil to erosion when all other factors remain constant. It is a result of properties of the soil. K values for a particular soil are determined experimentally using a rate of soil loss per erosion index unit. The K factor can be found on the SCS, Soil Interpretations Record, Form 5, when the soil series is known. An alternative method is to use the procedure summarized in Figure 3.

The amount of surface rock present affects soil erddibility. The K value is based essentially on rock-free erosive capability. The K ~~f~~ value taken from the Form 5 or derived from figure 3 can be adjusted for the amount of rock content by using the formula:

$$Ka=KCk$$

where Ka is the adjusted value of K; K is the erodibility factor from Form 5 or figure 3, and Ck is the surface rock adjustment factor found in Figure 4.

Topographic Factor, LS. Both the length of a slope and its steepness substantially affect the rate of soil erosion by water. Since the erosive force increases with the velocity of flow, a longer or steeper slope would increase the rate of erosion. The slope(S) and slope length (L) are expressed in a single factor, defined as the distance from the point of origin of the overland flow to the point of deposition. The slope is the percent slope of the flow line. Since small errors in S or L will reflect large errors in the USLE, values should be from field measurements and not taken from maps. Values for temperature regimes A-1 and A-3 are found in figure 5~~regime~~ and 6; for regimes A-2 in figure 7.

Irregular Slopes

Soil loss is also affected by the shape of a slope. Many slopes either steepen toward the lower end (convex slope) or flatten toward the lower end (concave slopes). Use of an average gradient in finding LS would overestimate soil loss for concave slopes and underestimate for convex slopes. Irregular slopes should not be evaluated as independent slopes when runoff flows from one segment to the next.

Irregular slopes can usually be divided into segments that have nearly uniform gradients. The LS factor is determined for each segment from figure 3 or 4. Each segment's LS factor is then weighted by relative soil loss factor (Sf). Then summed for all segments.

$$Sf = \frac{I^{m+2} - (I-1)^{m+1}}{n^{m+1}}$$

Where: I = Sequence Number of Segment starting at the top of the slope

m = Slope-length exponent (.5 for Slopes $\geq$ 5% , .4 for 4% and .3 for slopes $\leq$ 3%)

n = Number of equal-length segments

$$LSa = \sum_{i=1}^{n} Ls_i \; Sf_i$$

Where: LSa = irregular slope topographic factor (LS) used in soil loss equation

Sf_i = weighting factor for the i segment

n = number of segments

The above procedure assumes that (1) the changes in gradient are <u>not</u> sufficient to cause upslope deposition and (2) the irregular slopes can be divided into a small number of equal-length segments, with uniform gradients.

<u>Cover and Management Factor, C</u>. The erodibility of a slope is influenced by the vegetative cover on the slope, the amount of organic residue on the surface, and the organic residue in the soil. The Cover and Management Facotr is an expression of the influences of the organic component on the erosion capability. The value C is found by the formula:

$$C=C1C2C3$$

where each value of Cn expresses one of the three influencing factors.

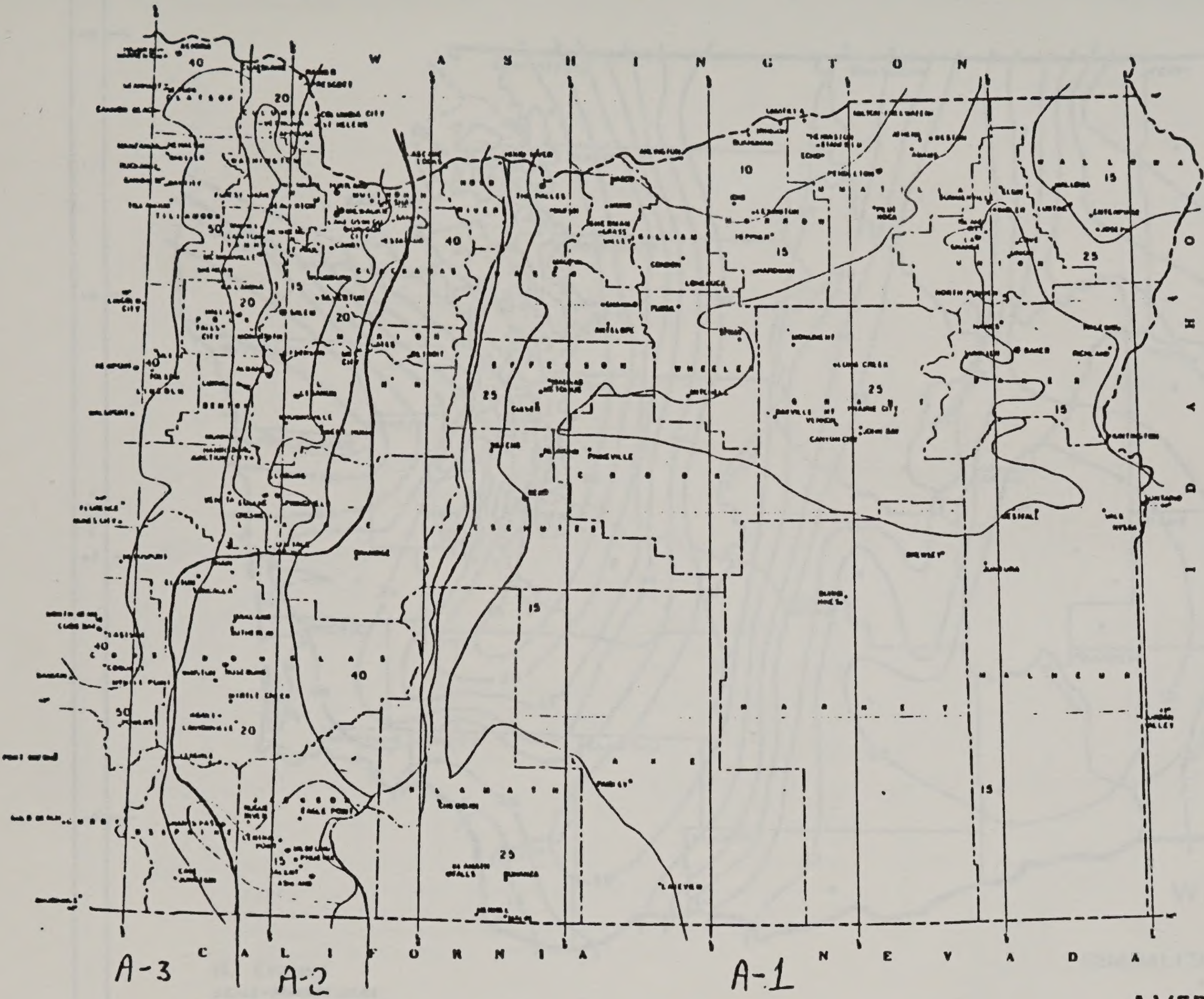
C1-the influence of canopy and cover on raindrop efficiency and intensity, reducing the erosive energy of precipitation. Values can be found on Figure 8.

C2 - The influence of organic residue and litter on the soil surface, found in Figure 9.

C3 - The influence of organic residues in the soil. This includes roots and sod, and other organic matter that reduce the erosive inluence of runoff. Values can be found in Figure 10.

Support Practice Factor, P. Steps can be taken to reduce the erosive influence of runoff, including terracing, stilling basins, and other methods of breaking flow velocities and reducing sediment transport. The Support Practice Factor, P, is an expression of these actions. Most of the values for P, which range from a low of 0.01 to a high of 1.0, have been developed for agricultural lands. For steep slopes where no supportive practices are used, the values for P would be around 0.9 to 1.0. Where some steps have been taken, such as leaving windrows in chainings or terracing rangelands, the values would probably be around 0.5 for P. In the absence of specific values, it is necsssary to estimate the value which, for most lands will be between 0.5 to 1.0.

FIG. 1



AVERAGE ANNUAL RAINFALL FACTOR (R)

OREGON

MARCH 1977

SCALE 1:3,500,000

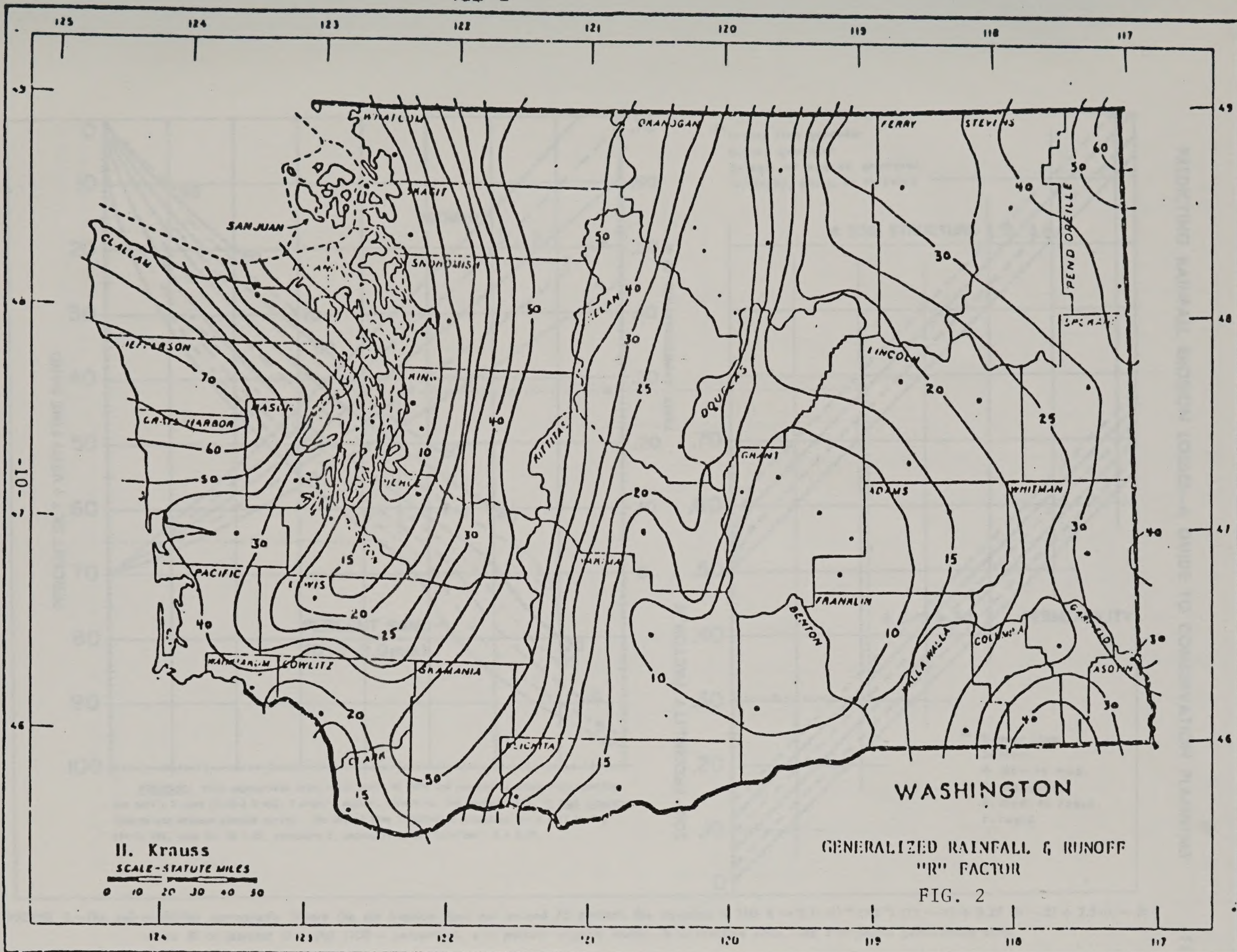
R AVERAGE ANNUAL RAINFALL FACTOR
(For use in Universal Soil Loss Equation)

Source:
Base map prepared by SCS, WTSC Carto. Unit from USGS 1:1,000,000 National Atlas.
Thematic detail compiled by State Staff
US DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE

M7-OL-19092-7

TECHNICAL GUIDE
SECTION I-A-2

MAP 2



GENERALIZED RAINFALL & RUNOFF
"R" FACTOR
FIG. 2

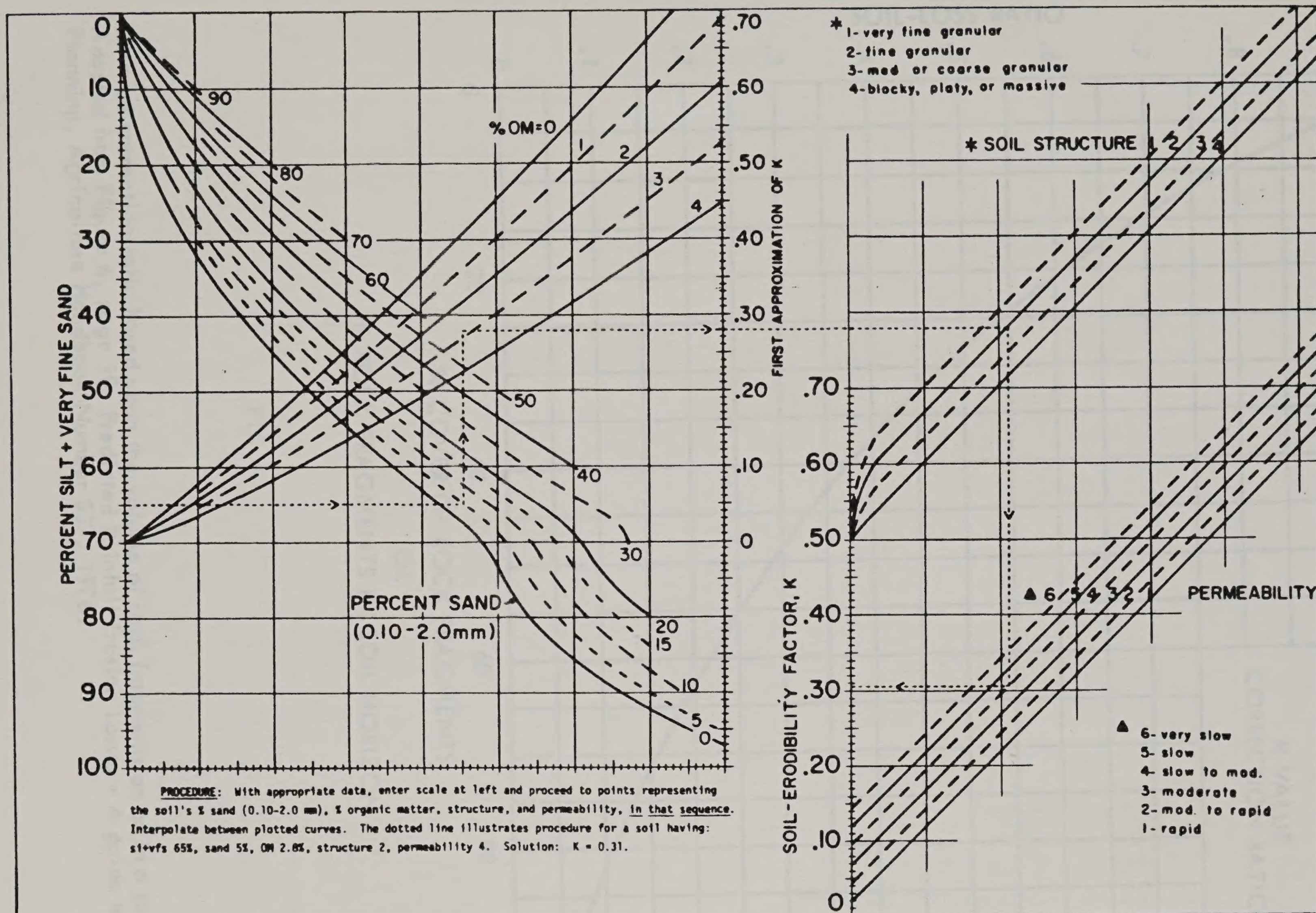


FIGURE 3.—The soil-erodibility nomograph. Where the silt fraction does not exceed 70 percent, the equation is $100\ K = 2.1\ M^{1.14}\ (10^{-4})\ (12 - a) + 3.25\ (b - 2) + 2.5\ (c - 3)$ where $M =$ (percent si + vfs) (100 — percent c), a = percent organic matter, b = structure code, and c = profile permeability class.

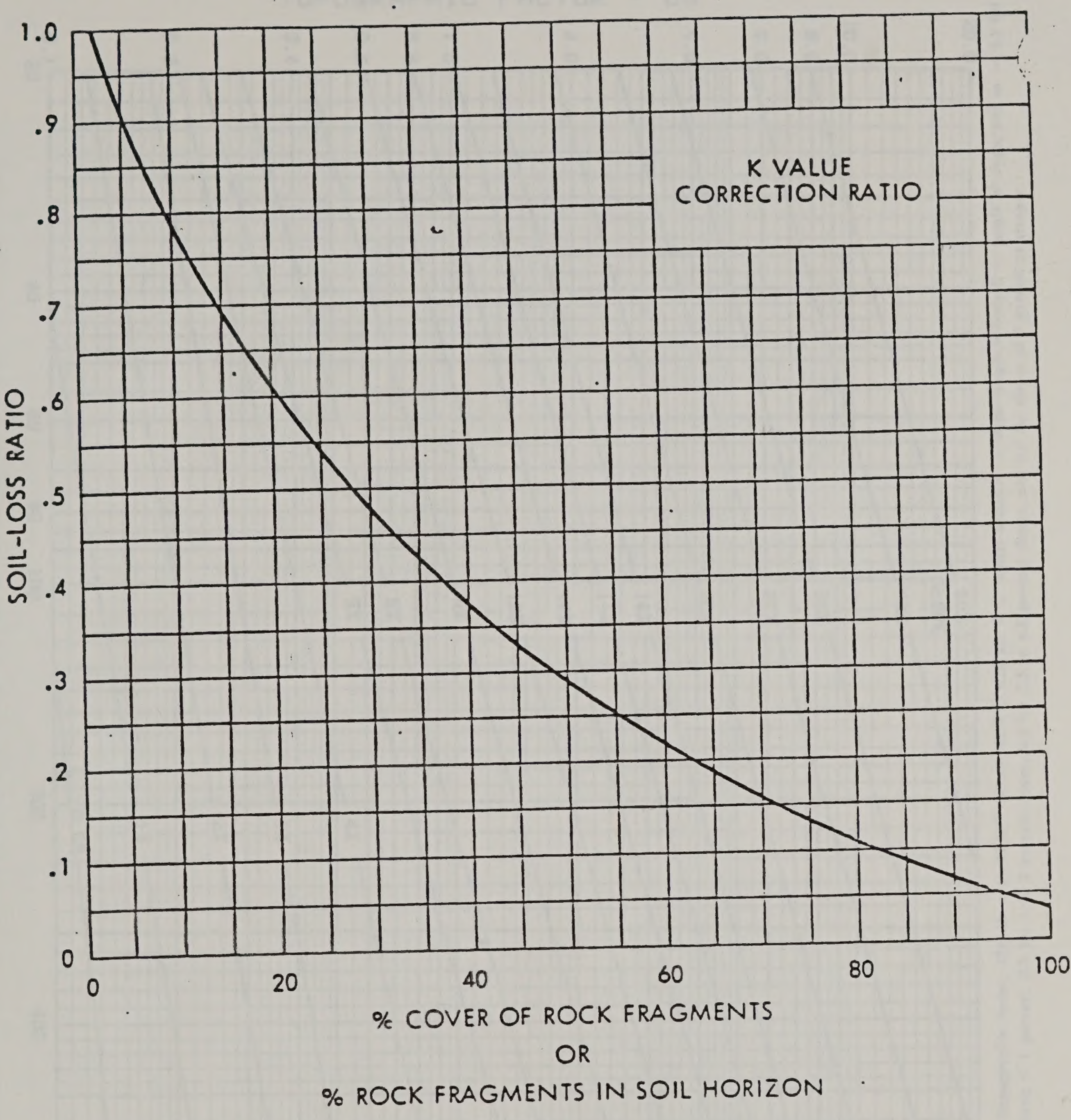


FIG 4

K value correction ratio based upon the volume of rock fragments on or in a soil horizon. Adapted from Figure 6, page 19, Predicted Rainfall Erosion Losses - A guide to Conservation Planning, Agriculture Handbook Number 537, 1978.

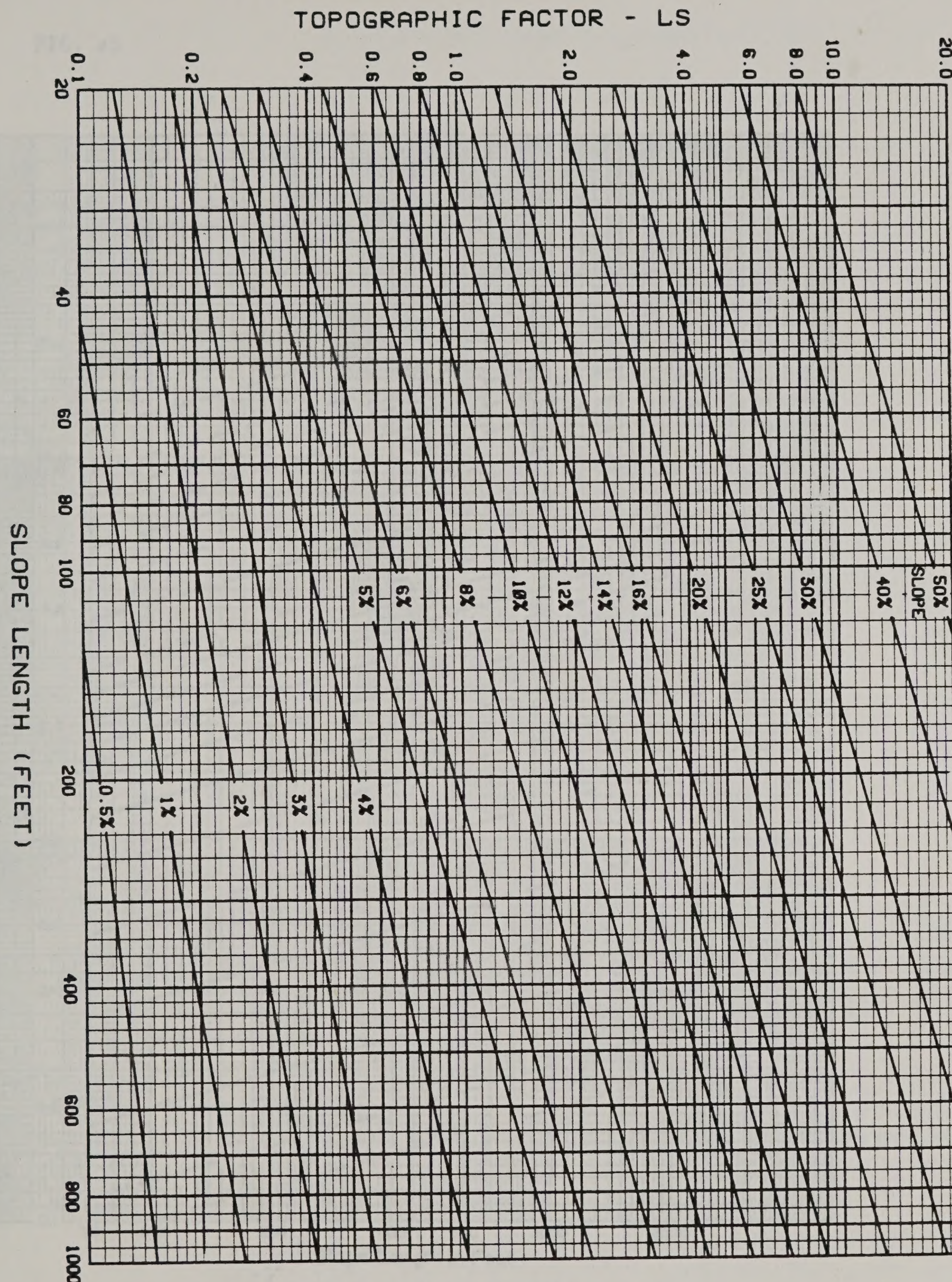
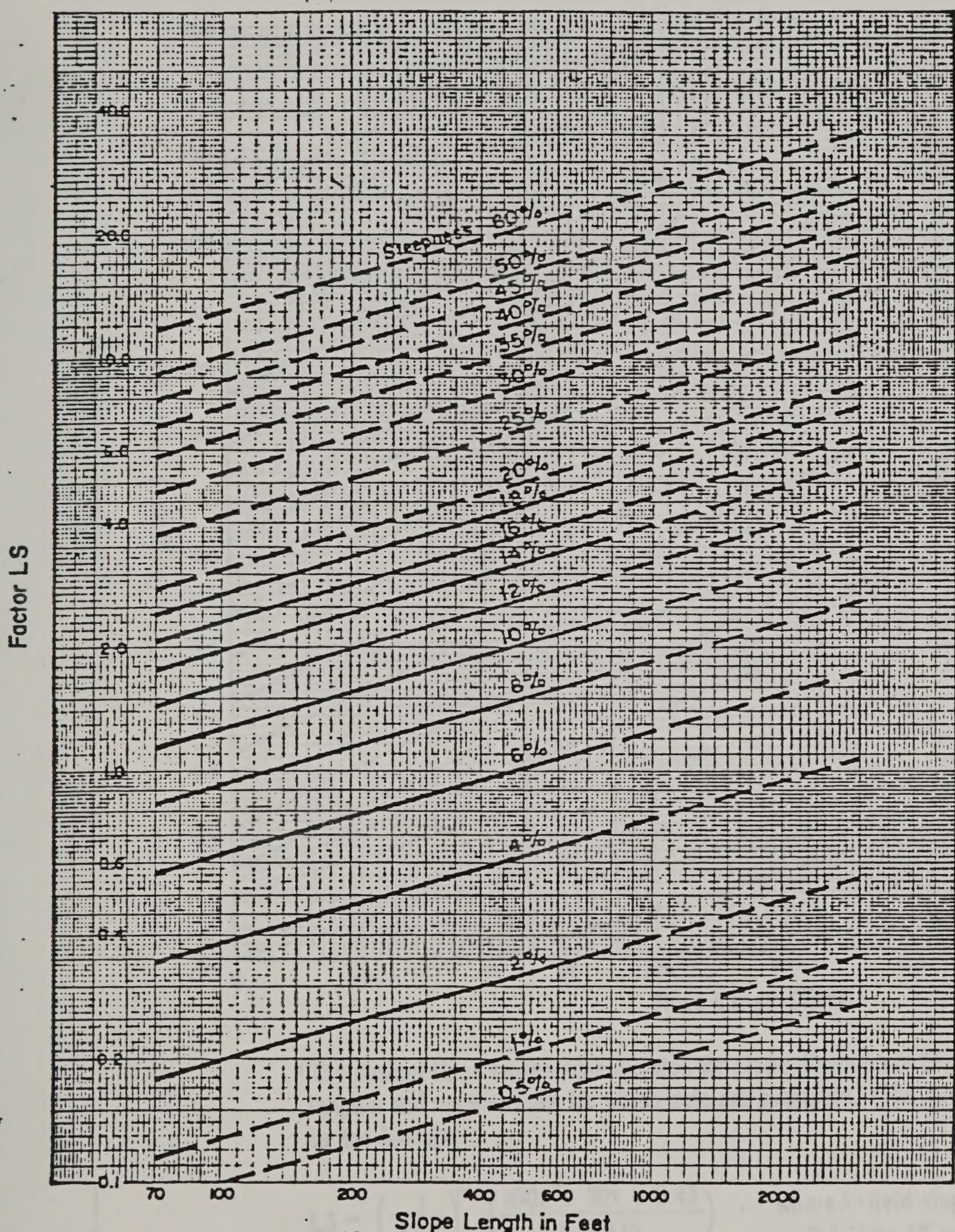


FIG. 5 —Slope-effect chart (topographic factor, LS). LS = $(\lambda/72.6)^m$ $(65.41 \sin^2\theta + 4.56 \sin\theta + 0.065)$ where λ = slope length in feet; θ = angle of slope; and m = 0.2 for gradients < 1 percent, 0.3 for 1 to 3 percent slopes, 0.4 for 3.5 to 4.5 percent slopes, and 0.5 for slopes of 5 percent or steeper.

FIG. ¢6



Applicable to Soil Moisture-Soil Temperature
Regimes A-1 in WN, OR, and ID; and in A-3

Note: Dashed lines are extensions of LS Formulae beyond values tested in studies.

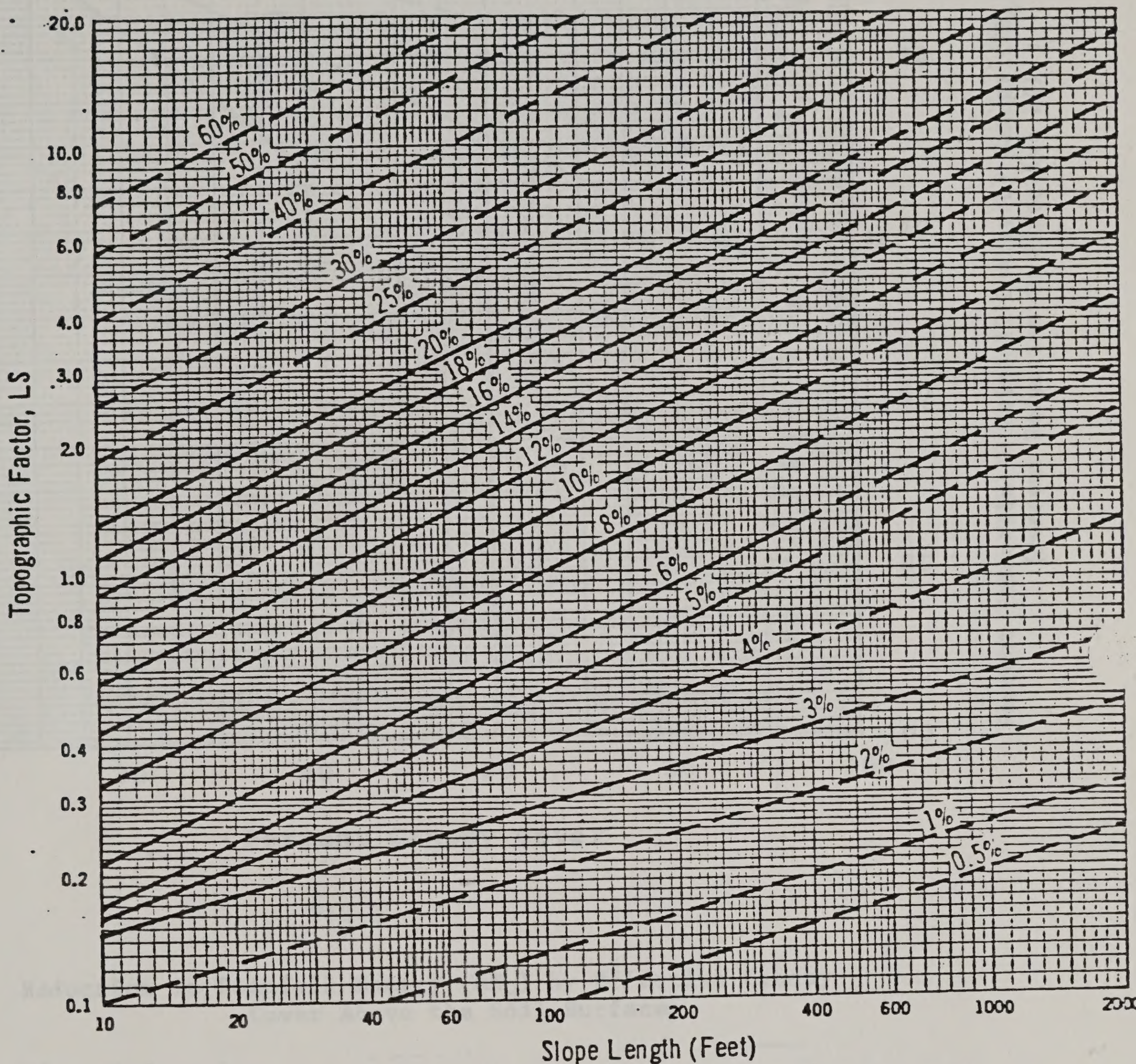
For slopes less than 9% $LS = \left(\frac{\ell}{72.6}\right)^{0.3} \left(\frac{0.43 + 0.30 + 0.043s^2}{6.613}\right)$

For slopes greater than 9% $LS = \left(\frac{\ell}{72.6}\right)^{0.3} \left(\frac{s}{9}\right)^{1.3}$

ℓ=length of slope
s=percent slope

FIG. 7 Applicable to all Soil Moisture - Soil Temperature Regimes except A=3, and A-1 in WN, OR, and ID.

SLOPE-EFFECT CHART (Topographic Factor, LS)*



*The dashed lines represent estimates for slope dimensions beyond the range of lengths and steepnesses for which data are available. The curves were derived by the formula:

$$LS = \left(\frac{\lambda}{72.6}\right)^m \left(\frac{430x^2 + 30x + 0.43}{6.57415}\right)$$

where λ = field slope length in feet and m = 0.5 if s = 5% or greater, 0.4 if s = 4%, and 0.3 if s = 3% or less; and x = sin θ. θ is the angle of slope in degrees.

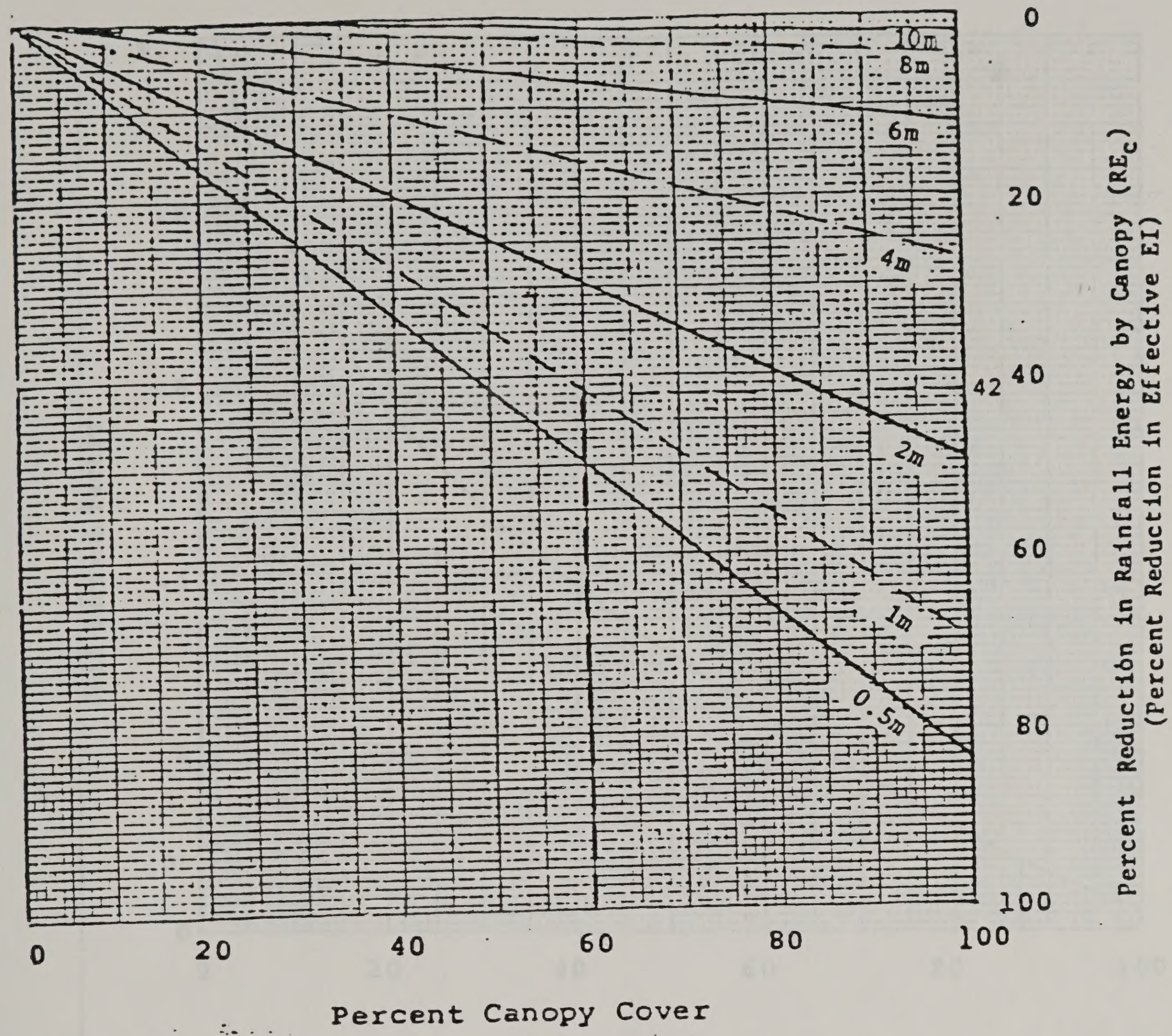


FIG 8

Reduction in Rainfall Energy (RE_c) by Effective Canopy Cover Above the Soil Surface

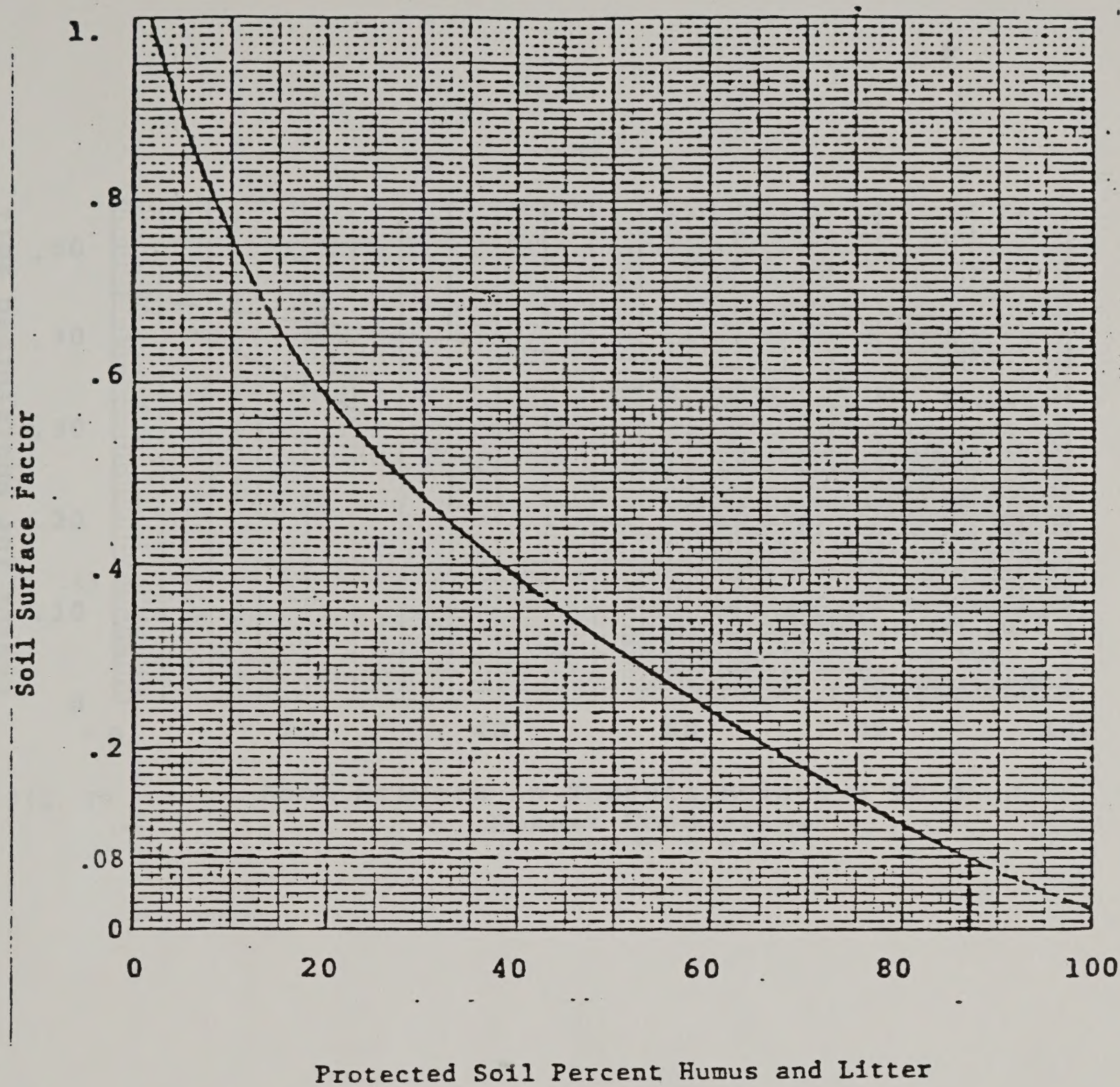


FiG. 9

Cover in Direct Contact with the Soil Surface, Type I Effect

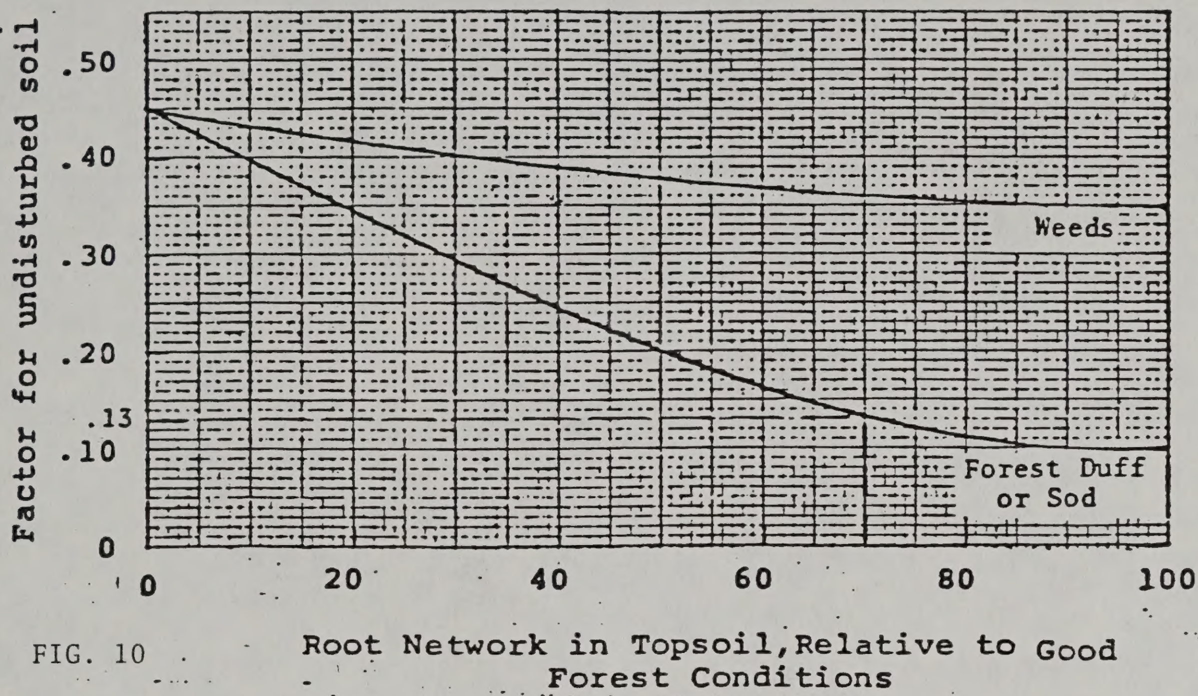


FIG. 10

Effect of No Soil Disturbance for at Least 10 Years, Root Accumulation in the Upper Layer of Soil, and other Related Factors, Type III Effect

APPENDIX V.

SEDIMENT YIELD FACTOR RATING

The sediment yield from a basin or area can be estimated using the following sediment yield rating form. The numerical value is estimated for each of the factors, the total obtained, and the sediment yield found from the accompanying graph. The value is only an estimate for any given area, an estimate over a period of time, rather than an instantaneous measurement or estimate of yield.

STREAM ____________ WATERSHED ____________ DATE ________

LOCATION ____________ T_____ R_____ SECT________

SURVEYOR ____________ P.U. ____________ COUNTY ____________

SEDIMENT YIELD FACTOR RATING

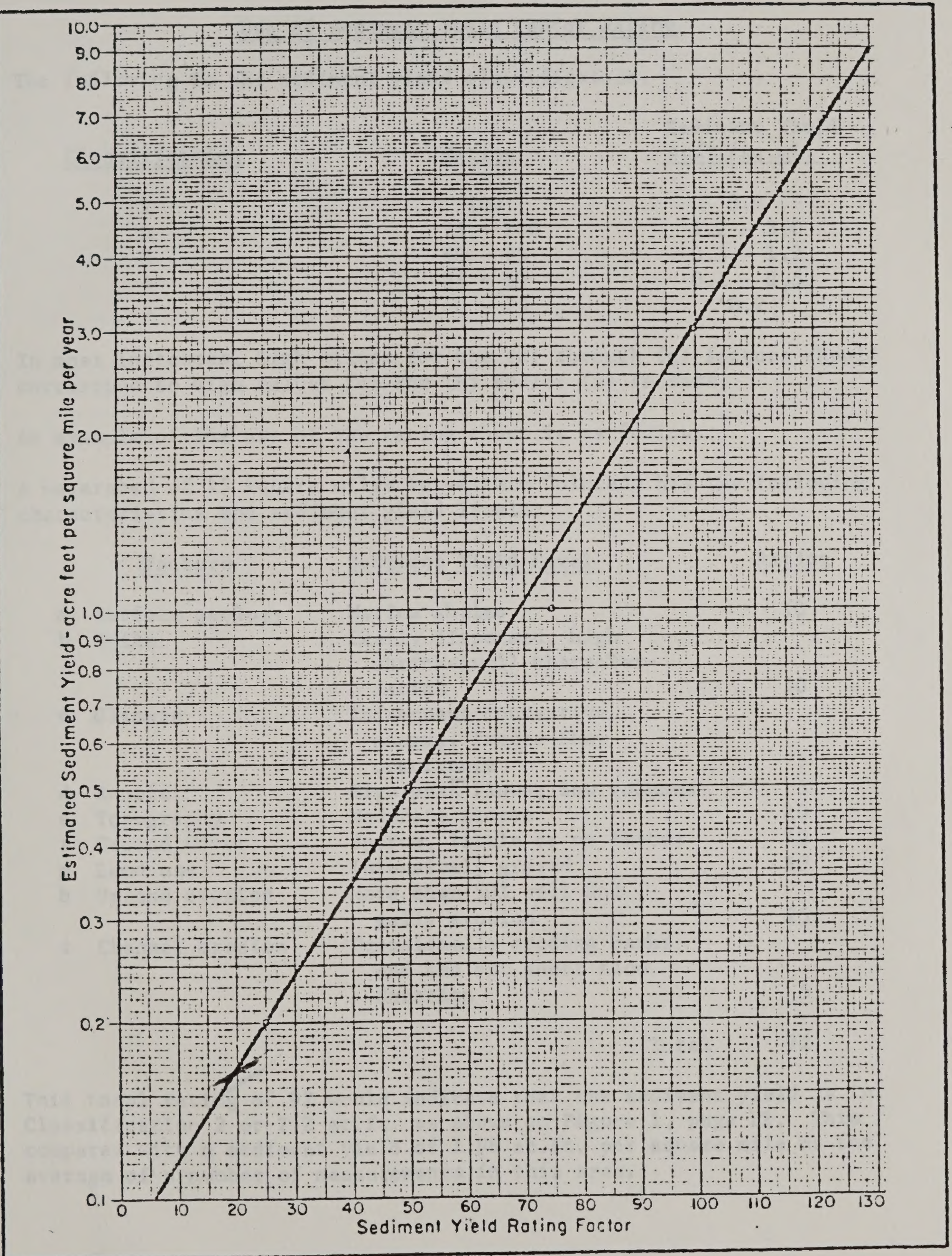
SURFACE GEOLOGY (a)	SOILS (b)	CLIMATE (c)	RUNOFF (d)	TOPOGRAPHY (e)
(10) a. Marine shales and related mudstones and siltstones	(10) a. Fine textured; easily dispersed; saline-alkaline; high shrink-swell characteristics b. Single grain silts and fine sands	(10) a. Storms of several days' duration with short periods of intense rainfall b. Frequent intense convective storms c. Freeze-thaw occurrence	(10) a. High peak flows per unit area b. Large volume of flow per unit area	(20) a. Steep upland slopes (in excess of 30%) b. High relief; little or no floodplain development
(5) a. Rocks of medium hardness b. Moderately weathered c. Moderately fractured	(5) a. Medium textured soil b. Occasional rock fragments c. Caliche layers	(5) a. Storms of moderate duration and intensity b. Infrequent convective storms	(5) a. Moderate peak flows per unit area b. Moderate volume of flow per unit area	(10) a. Moderate upland slopes (less than 20%) b. Moderate fan or floodplain development
(0) a. Massive, hard formations	(0) a. High percentage of rock fragments b. Aggregated clays c. High in organic matter	(0) a. Humid climate with rainfall of low intensity b. Precipitation in form of snow c. Arid climate, low intensity storms d. Arid climate; rare convective storms	(0) a. Low peak flows per unit area b. Low volume of runoff per unit area c. Rare runoff events	(0) a. Gentle upland slopes (less than 5%) b. Extensive alluvial plains
Factor value				

GROUND COVER (f)	LAND USE (g)	UPLAND EROSION (h)	CHANNEL EROSION AND SEDIMENT TRANSPORT (i)
(10) Ground cover does not exceed 20% a. Vegetation sparse; little or no litter b. No rock in surface soil	(10) a. More than 50% cultivated b. Almost all of area intensively grazed c. All of area recently burned	(25) a. More than 50% of the area characterized by rill and gully or landslide erosion	(25) a. Eroding banks continuously or at frequent intervals with large depths and long flow duration b. Active headcuts and degradation in tributary channels
(0) Cover not exceeding 40% a. Noticeable litter b. If trees present understory not well developed	(0) a. Less than 25% cultivated b. 50% or less recently logged c. Less than 50% intensively grazed d. Ordinary road and other construction	(10) a. About 25% of the area characterized by rill and gully or landslide erosion b. Wind erosion with deposition in stream channels	(10) a. Moderate flow depths, medium flow duration with occasionally eroding banks or bed
(−10) a. Area completely protected by vegetation, rock fragments, litter b. Little opportunity for rainfall to reach erodible material	(−10) a. No cultivation b. No recent logging c. Low intensity grazing	(0) a. No apparent signs of erosion	(0) a. Wide shallow channels with flat gradients and short flow duration b. Channels in massive rock, large boulders, or well vegetated c. Artificially controlled channels
Factor value			

Subtotal (a) – (g)	Subtotal (h) – (i)	TOTAL RATING – – – = – – . – ac.ft./sq. mi./yr.

FIGURE 1

SEDIMENT YIELD RATING FACTOR



Use of Sediment Yield Factor Rating

The following is the sediment yield classification.

Classification	Rating	Sediment Yield ac.ft./sq.mi.
1	100	3.0
2	75 - 100	1.2 - 3.0
3	50 - 75	0.5 - 1.2
4	25 - 50	0.2 - 0.5
5	0 - 25	0.2

In most instances, high values for the (a) through (g) factors should correspond to high values for the (h) and/or (i) factors.

An example of the use of the rating chart is as follows:

A watershed of 15 square miles in western Colorado has the following characteristics and sediment yield levels:

	Factors	Sediment Yield Level	Rating
a	Surface geology	Marine shales	10
b	Soils	Easily dispersed, high shrink-swell characteristics	10
c	Climate	Infrequent convective storms, freeze-thaw occurrence	7
d	Runoff	High peak flows; low volumes	5
e	Topography	Moderate slopes	10
f	Ground Cover	Sparse, little or no litter	10
g	Land use	Intensively grazed	10
h	Upland erosion	More than 50% rill and gully erosion	25
i	Channel erosion	Occasionally eroding banks and bed but short flow duration	5
		Total	92

This total rating of 92 would indicate that the sediment yield is in Classification 2 or 2.2 ac.ft. as shown on Figure 1, page 12. This compares with a sediment yield of 1.96 ac.ft. per square mile as the average of a number of measurements in this area.

APPENDIX VI
POOL QUALITY RATING SYSTEM

For each pool to be rated, select the appropriate value:

Pool size
- 3-Pool larger or wider than average width of stream
- 2-Pool as wide or long as average width of stream.
- 1-Pool shorter or narrower than average width of stream

Depth Ratings
- First through Fourth Order Streams
  - 3-Over three feet deep
  - 2- 2-3 feet deep
  - 1- under 2 feet deep
- Fifth Order Streams or larger
  - 3- Depth 20% of average stream width or greater
  - 2- Depth 10-20% of average stream width
  - 1- Depth less than 10% of average stream width

Cover Ratings
- 3-Abundant Cover
- 2-Partial Cover
- 1-Exposed

Total Ratings	Pool Class
8-9	1
7	2
5-6*	3
4-5	4
3	5

*Sum of five must include 2 for depth and 2 for cover.

APPENDIX VII

STREAM HABITAT AND CHANNEL STABILITY

The following procedures were developed by the U.S. Forest Service, and have been tested in a variety of situations. Based on the experience of a number of BLM personnel, some of the definitions were rewritten. Point totals remain the same except for the category on channel width and capacity which, because of experience in arid regions, was inscreased in point totals to reflect a greater importance.

In use, the form is filled out for each inventory reach or section. In the reporting, the values for each category can be reported, or values can be given as totals or as fair, poor, good or excellent. Procedures for using the form with a fuller explanation of categories is appended, using the original instructions from the U.S. Forest Service.

STREAM HABITAT AND CHANNEL STABILITY SURVEY FORM

STREAM ________________ WATERSHED ________________ LOCATION ________________ R ______ T ______ SECT ______
DATE ____________ TIME __________ AIR TEMP ________ C WATER TEMP ______ C FLOW ____________ CFS AVE. WIDTH __________ AVE. DEPTH __________
RESOURCE AREA ________________ Observer(s) ________________

STABILITY INDICATORS BY CLASSES

		Item Rated	Excellent		Good		Fair		Poor	
UPPER BANKS	1	Landform Slope	Bank Slope Gradient over 30%	2	Bank Slope Gradient 30-40%	4	Bank Slope Gradient 40-60%	6	Bank Slope Gradient over 60%	8
	2	Mass wasting or failure, existing or potential	No evidence of past or any potential for future mass wasting into channel	3	Infrequent and/or small, healing over. Low potential for future wasting	6	Moderately frequent, moderate size; some spots; erodible mostly at high flows	9	Frequent or large size; constantly eroding or in imminent danger of erosion	12
	3	Debris jam potential (floatable objects)	Essentially absent from immediate channel area	2	Present. Amount small, stable or declining. Mostly small in size, with few large limbs or trees	4	Present. Moderate or increasing in amount. All sizes, many large limbs and trees	6	Abundant, predominantly larger size	8
	4	Vegetative bank protection	90% plant density; vigor and variety suggest a deep dense soil binding, root mass	3	70-90% density. Plant species and moderate vigor suggest moderately dense and deep root mass	6	50-70% density. Limited diversity and fair vigor. Somewhat discontinuous and shallow root mass	9	Under 50% density. Few species, poor vigor. Poor, shallow and sparse root mass.	12
	5	Channel width and capacity	Channel well-defined, ample for all but flood flows. Few or no gravel bars or flats	4	Most of channel well defined. Ample for most high flows. Some channel spreading and gravel bars	8	Main channel usually defined; some channel shifting. Overflow at higher flows. Channel spreading common	12	Channel poorly defined, often changing, wide spread, mostly silt and gravel bard	16
	6	Bank rock content	Over 60% bank with large boulders, 12" or more numerous	2	40-60%. Some large boulders; mostly smaller boulders and cobbles, 6-12"	4	20-40%. Mostly in 3-6" range or smaller	6	Under 20%. Most in rock fragments 3" or less	3
LOWER BANKS	7	Obstructions Flow deflectors sediment traps	Pools & riffles stable. Logs & rocks firmly imbedded. Flow not causing cutting or deposition	2	Some present, causing erosive cross currents and minor pool filling. Deflectors new, less firm	4	Shifting, moderately frequent, unstable obstructions, causing bank cutting and pool filling	6	Frequent unstable obstructions and deflectors causing continuous bank erosion. Sed. traps full	8
	8	Bank cutting	Little or none evident. Infrequent raw banks, small in area	4	Some, intermittent, most at out curves and constrictions, moderate in size	8	Sizeable cuts, often fresh and active. Root mat overhangs, and sloughing evident	12	Many extended cuts, frequently 3' or higher. Failure and sloughing common	16
	9	Deposition	Little or no enlargement of channel, no bars on corners	4	Some periodic channel enlargement, some new bar formation of mostly coarse material	8	Some channel enlargement Moderate formation of new bars by gravel and coarse sand	12	Wide channel enlargement Extensive depositing of fine particles. Accelerated bar development	16
BOTTOM	10	Rock Angularity	Sharp edges and corners plane surfaces roughened	1	Rounded corners and edges surface smooth and flat	2	Corners and edges well rounded in two dimensions	3	Well rounded in all dimensions, surfaces smooth	4
	11	Brightness	Surfaces dull, darkened or stained, generally not bright	1	Mostly dark, dull, but up 35% bright surfaces	2	35-65% dull, usually 50-50% dull and bright	3	Predominantly bright, over 65% exposed or scoured surfaces	4
	12	Consolidation or particle packing	Assorted sizes, tightly packed and/or overlapping. Bottom firm.	2	Moderately packed, some overlapping. Bottom moderately firm.	4	Loose assortment, some overlap. Bottom dislodged easily with foot.	6	No packing evident. Loose assortment. Shifts readily underfoot.	8
	13	Bottom size distribution and percent stable	Size bottom material consistent along stream. Stable material 80-100%	4	Some changes in bottom material along stream. Stable material 20-50%	8	Moderate changes in sizes along channel. Stable material 20-50%	12	Marked distribution changes. Stable material 0-20%.	16
	14	Scouring and deposition.	Less than 5% of bottom affected by scouring and deposition.	6	5-30% affected. Scour at constrictions and where grade steepens. Deposits in pools and at corners.	12	30-50% affected. Deposits and scour at obstructions, bends, constrictions. Pools generally filled.	18	Over 50% of bottom in state of flux nearly all year.	24
	15	Clinging aquatic vegetation (moss and algae)	Abundant. Growth largely mosslike, dark green, perennial. In swift water aquatic plants common.	1	Common. Algal forms in lower velocity areas. Moss in quiet and flowing waters. Aquatic plants present.	2	Present, spotty, mostly in backwater areas. Seasonal blooms. Make rocks slick. Aquatic plants rare.	3	Perennial types scarce or absent. Some blooms, yellow-green in color may occur.	4
			Excellent column total		Good column total		Fair column total		Poor column total	

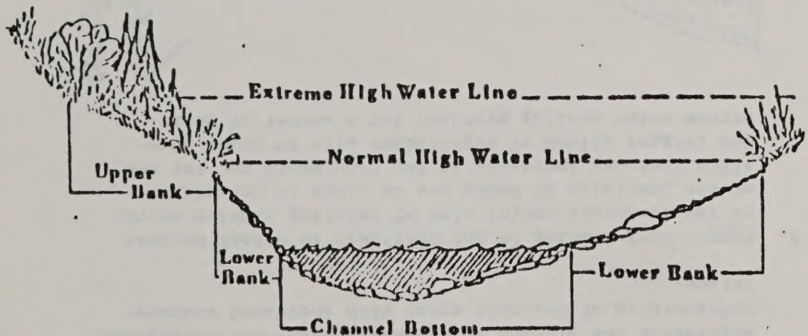
E ________ + G ________ + F ________ + P ________ + = ________ Total 42+ excellent, 42-82 = good, 83-123 = fair, 124 = poor

DEFINITION OF TERMS AND ILLUSTRATIONS

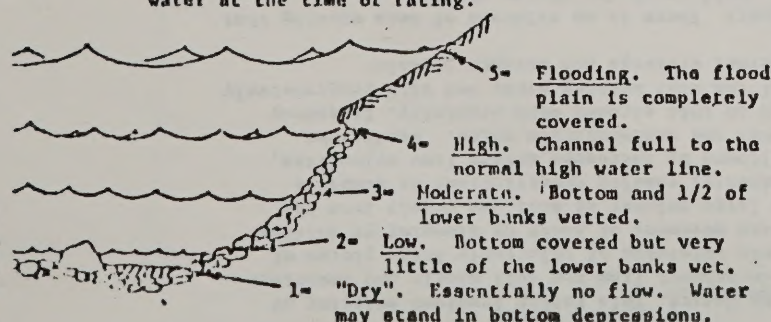
Upper Bank - That portion of the topographic cross section from the break in the general slope of the surrounding land to the normal high water line. Terrestrial plants and animals normally inhabit this area.

Lower Banks - The intermittently submerged portion of the channel cross section from the normal high water line to the water's edge during the summer low flow period.

Channel Bottom - The submerged portion of the channel cross section which is totally an aquatic environment.



Stream Stage - The height of water in the channel at the time of rating is recorded, using numbers 1 through 5. These numbers, as shown below, relate to the surface water elevation relative to the normal high water line. A decimal division should be used to more precisely define conditions, i.e., 3.5 means 3/4ths of the channel banks are under water at the time of rating.



Amplification of the Stream Channel Evaluation Items

General

Space on the field form permits only the very briefest description of the various components. This field booklet provides, in the text which follows, some of the basic rationale in support of these brief "kernels" or core thoughts. These explanations are arranged in the same order as they appear on the field form.

The channel cross section is subdivided into three components, to focus your attention on the various indicators to be subjectively evaluated. Once again, you are cautioned not to "key in" on any one item or group of items. All that have been included are interrelated and all must be used in an unbiased way to achieve consistent evaluations of the current situation.

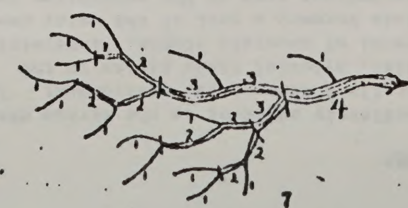
Stream channel ratings should not be attempted without the preparation provided by this Field Guide. The language of the text has been kept rather general to avoid limiting its use as a management tool to a small geographic area. These general descriptions, coupled with your local experience, will stimulate mental images of indicator conditions which, when shared with fellow workers, will lead to consistent, reproducible ratings.

Illustrations in the text should be considered general in nature and not specific for all situations. It is suggested that local conditions be photographed and the pictures added to this Field Guide to achieve local uniformity.

A word of additional caution: Keep the scale of the reach being evaluated in context with the scale of dimensions given in the text and on the inventory form. Rating items were taylored for and best fit the 2nd to 4th order stream reaches. Very small, unbranched, first order segments will require a scaling down of sizes while the larger stream and river reaches will require some mental enlargement of the criteria given to fit the situation.

STREAM ORDER CLASSIFICATION

First order streams are unbranched reaches found usually but not exclusively at the head of drainage basins. Second order reaches are formed when two or more first order reaches come together and so on as illustrated below.



I. Upper Channel Banks

The land area immediately adjacent to the stream channel is normally and typically a terrestrial environment. Landforms vary from wide, flat, alluvial flood plains to the narrow, steep termini of mountain slopes. Intermittently this dry land flood plain becomes a part of the water course. Forces of velocity and turbulence tear at the vegetation and land. These hydrologic forces, while relatively short lived, have great potential for producing onsite enlargements of the stream channel and downstream sedimentation damage. Resistance of the component elements on and in the bank are highly variable. This section is designed to aid in rating this relative resistence to detachment and transport by floods.

A. Landform Slope: The steepness of the land adjacent to the stream channel determines the lateral extent and ease to which banks can be eroded and the potential volume of slough which can enter the water. All other factors being equal, the steeper the land adjacent to the stream, the greater the potential volume of slough materials.

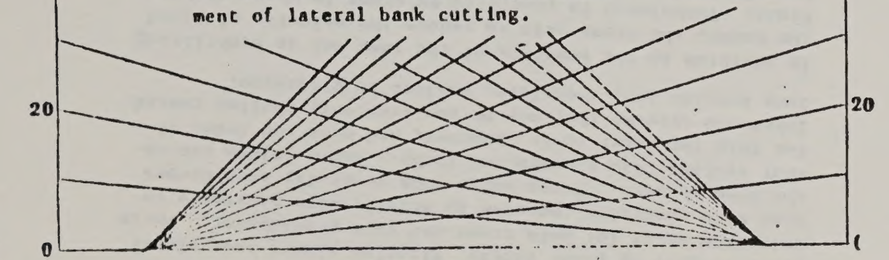
The 60% limit for poor was selected as a conservative gravitational repose angle for unconsolidated soil materials. Slopes steeper than this are rated poor because they would erode into the stream by gravity alone, if denuded of their protecting vegetation. The other ratings built on this limit and are arbitrarily set as follows:

1. Excellent: Side slopes to the channel are generally less than 30 percent on both banks.

2. Good: Side slopes up to 40% on one or occasionally both banks.

3. Fair: Side slopes to 60% common on one or both banks.

4. Poor: Steep slopes, over 60%, provide larger volumes of soil for downstream sedimentation for each increment of lateral bank cutting.



PERCENT SLOPE SCALE
Hold this page at arms length..match the slope of the topography with the percent slope lines on the scale above.

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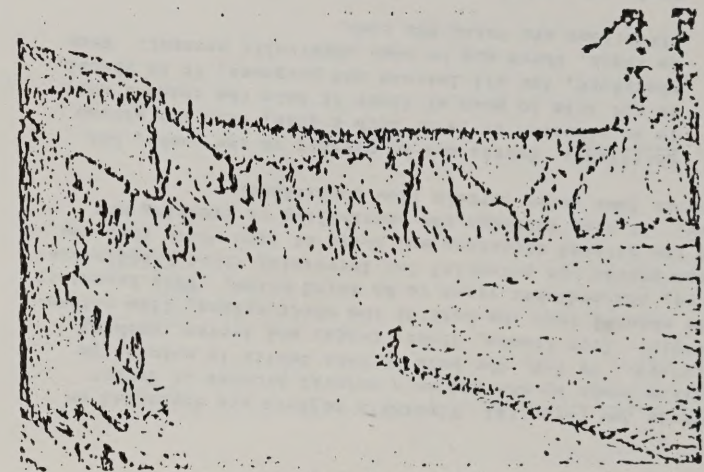
B. Mass Wasting Hazard This rating involves existing or potential detachment from the soil mantle and downslope movement into waterways of relatively large pieces of ground. Mass movement of banks by slumping or sliding introduces large volumes of soil and debris into the channel suddenly, causing constrictions or complete damming followed by increased stream flow velocities, cutting power and sedimentation rates. Conditions deteriorate in this element with proximity, frequency and size of the mass wasting areas and with progressively poorer internal drainage and steeper terrain:

1. Excellent: There is no evidence of mass wasting that has or could reach the stream channel.

2. Good: There is evidence of infrequent and/or very small slumps. Those that exist may occasionally be "raw" but predominately the areas are revegetated and relatively stable.

3. Fair: Frequency and/or magnitude of the mass wasting situation increases to the point where normal high water aggrevates the problem of channel changes and subsequent undercutting of unstable areas with increased sedimentation.

4. Poor: Mass wasting is not difficult to detect because of the frequency and/or size of existing problem areas or the proximity of banks are so close to potential sides that any increases in the flow would cut the toe and trigger slides of significant size to cause downstream water quality problems for a number of years.



Mass wasting of slopes directly into the stream channel.

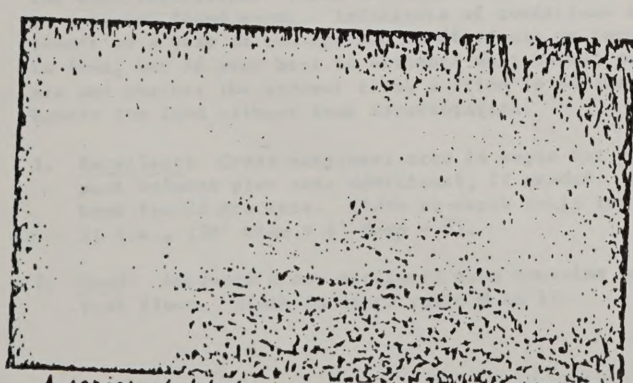
C. Debris Jam Potential Floatable objects are deposited on stream banks by man and as a natural process of forest ecology. By far, the bulk of this debris is natural in origin. Tree trunks, limbs, twigs, and leaves reaching the channel form the bulk of the obstructions, flow deflectors, and sediment traps to be rated below. This inventory item assess the potential for increasing these impediments to the natural direction and force of flow where they now lay. It also includes the possibility of creating new debris jams under certain flow conditions.

1. Excellent: Debris may be present on the banks, but is so situated or is of such a size, that the stream is not able to push or float it into the channel and, therefore, for all intents and purposes, it is absent. In truth, there may be none physically present. Both situations are rated the same.

2. Good: The debris present offers some bank protection for a while but is small enough to be floated away in time. Only small jams could be formed with this material alone.

3. Fair: There is a noticeable accumulation of all sizes and the stream is large enough to float it away, at certain times, thus decreasing the bank protection and adding to the debris jam potential downstream.

4. Poor: Moderate to heavy accumulations are present due to fires, insect attack, disease mortality, windthrow, or logging slash. High flows will float some debris away and the remainder will cause channel changes.



A series of debris jams of small size materials like the one shown in the center of this photo cause this item to be rated "Poor".

D. Vegetative Bank Protection: The soil in banks is held in place largely by plant roots. Riparian plants have almost unlimited water for both crown and root development. Their root mats generally increase in density with proximity to the open channel. Trees and shrubs generally have deeper root systems than grasses and forbs. Roots seldom extend far into the water table, however, and near the shore of lakes and streams they may be comparatively shallow rooted. Some species are, therefore, subject to windthrow.

In addition to the benefits of the root mat in stabilizing the banks, the stems help to reduce the velocity of flood flows. Turbulence is generated by stems in what may have been laminar flow. The seriousness of this energy release depends on the density of both overstory and understory vegetation. The greater the density of both, the more resistence displayed. Damage from turbulence is greatest at the periphery and diminishes with distance from the normal channel. Other factors to consider, in addition to the density of stems, are the varieties of vegetation, the vigor of growth and the reproduction processes. Vegetal variety is more desirable than a monotypic plant community. Young plants, growing and reproducing vigorously, are better than old, decadent stands.

1. Excellent: Trees, shrubs, grass and forbs combined cover more than 90 percent of the ground. Openings in this nearly complete cover are small and evenly dispersed. A variety of species and age classes are represented. Growth is vigorous and reproduction of species in both the under- and over-story is proceeding at a rate to insure continued ground cover conditions. A deep, dense root mat is inferred.

2. Good: Plants cover 70 to 90 percent of the ground. Shrub species are more prevalent than trees. Openings in the tree canopy are larger than the space resulting from the loss of a single mature individual. While the growth vigor is generally good for all species, advanced reproduction may be sparse or lacking entirely. A deep root mat is not continuous and more serious erosive incursions are possible in the openings.

3. Fair: Plant cover ranges from 50 to 70 percent. Lack of vigor is evident in some individuals and/or species. Seedling reproduction is nil. This condition ranked fair, based mostly on the percent of the area not covered by vegetation with a deep root mat potential and less on the kind of plants that make up the overstory.

4. Poor: Less than 50 percent of the ground is covered. Trees are essentially absent. Shrubs largely exist in scattered clumps. Growth and reproduction vigor is generally poor. Root mats discontinuous and shallow.

II. Lower Channel Banks

The channel zone is located between the normal high water and low water lines. Both aquatic and terrestrial plants may grow here but normally their density is sparse.

The lower channel banks define the present stream width. Stability of these channel banks is indicated under a given flow regimen by minor and almost imperceptable changes in channel width from year to year. In other words, encroachment of the water environment into the land environment is nil.

Under conditions of increasing channel flow, the banks may weaken and both cutting (bank encroachment) and deposition (bank extension) begin, usually at bends and points of constriction. Cutting is evidenced by steepening of the lower banks. Eventually the banks are undercut, followed by cracking and slumping. Deposition behind rocks or bank protrusions increase in length and depth.

As the channel is widened, it may also be deepened to accomodate the increased volume of flow. For convenience only, changes of channel bottoms are observed separately and last in this evaluation scheme.

A. Channel Capacity: Channel width, depth, gradient, and roughness determine the volume of water which can be transmitted. Over time channel capacity has adjusted to the size of watershed above the reach rated, to climate, and to changes of vegetation. Some indicators of change are widening and/or deepening of the channel which affects the ratio of width to depth. When the capacity is exceeded, deposits of soil are found on the banks and organic debris may be found hung up in the bank vegetation. These are expressions of the most recent flood event. Indicators of conditions as recent as a year or two ago may be difficult or impossible to find, but do your best to estimate what normal peak flows are and whether the present cross section is adequate to handle the load without bank deterioration.

1. Excellent: Cross sectional area is ample for present peak volumes plus some additional, if needed. Overbank floods are rare. Width to depth ratio less than 7; i.e., (36' wide ÷ 6' deep = 6).

2. Good: Adequate cross sectional area contains most peak flows. Width to depth ratio 8 to 15.

3. Fair: Channel barely contains the peak runoff in average years or less. Width to depth ratios range from 15 to 25.

4. Poor: Channel capacity generally inadequate. Overbank floods quite common as indicated by kind and condition of the bank plants and the position and accumulation of debris. Width to depth ratio 25 or more.

B. Bank Rock Content: Examination of the materials that make up the channel bank will reveal the relative resistence of this component to detachment by flow forces. Since the banks are perennially and intermittently both aquatic and terrestrial environments, these sites are harsh for most plants that make up both types. Vegetation is, therefore, generally lacking and it is the volume, size and shape of the rock component which primarily determine the resistence to flow forces.

A soil pit need not be dug. Surface rock and exposed cut banks will enable you to categorize this item as listed by percentage ranges on the field form.

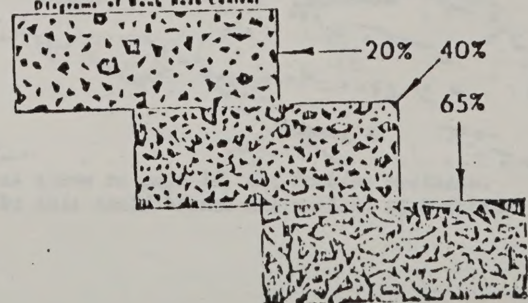
1. Excellent: Rock makes up 65% or more of the volume of the banks. Within this rock matrix large, angular boulders 12" (on their largest axis) are numerous.

2. Good: Banks 40-65% rock which are mostly small boulders and cobble ranging in size from 6-12" mean diameter. Some may be rounded while others are angular.

3. Fair: 20-40% of bank volume rock. While some big rock may be present, most fall into the 3-6" diameter class.

4. Poor: Less than 20% rock fragments, mostly of gravel sizes 1-3" in diameter.

Diagrams of Bank Rock Content



C. Obstructions and Flow Deflectors: Objects within the stream channel, like large rocks, embedded logs, bridge pilings, etc., change the direction of flow and sometimes the velocity as well. Obstructions may produce adverse stability effects when they increase the velocity and deflect the flow into unstable and unprotected banks and across unstable bottom materials. They also may produce favorable impacts when velocity is decreased by turbulence and pools are formed.

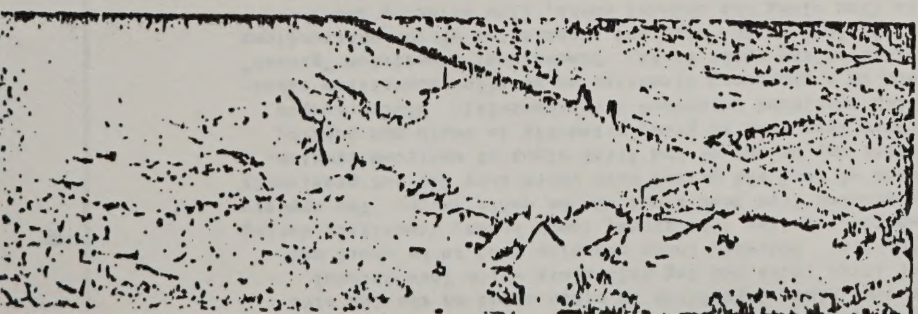
Sediment Traps: Channel obstructions which dam the flow partly or wholly form pools or slack water areas. The pools lower the channel gradient. With this loss of energy the sediment transport power is greately reduced. Coarse particles drop out first at the head of the pool. Some or all of the fine suspended particles may carry on through.

Embedded logs and large boulders can produce very stable natural dams which do not add to channel instability. Some debris dams and beaver dams, however, are quite unstable and only serve to increase the severity of channel damage when they break up.

The effectiveness of these sediment traps depends on pool length relative to entrance velocity. The swifter the current, the longer the pool needed to reach zero velocity. Turbulence caused by a falls at the head of the pool shortens the length required to reach zero velocity.

How long these traps are effective depends on depth and width as well as pool length and, of course, the rate of sediment accretion.

Items of vegetation growing in the water, like alders, willows, cattails, reeds, and sedges are also effective traps in some locations and reduce flow velocity and sediment carrying power.



Overturned shoreline trees become obstructions and flow deflectors as shown here. If frequent in the reach, rate this item "Poor".

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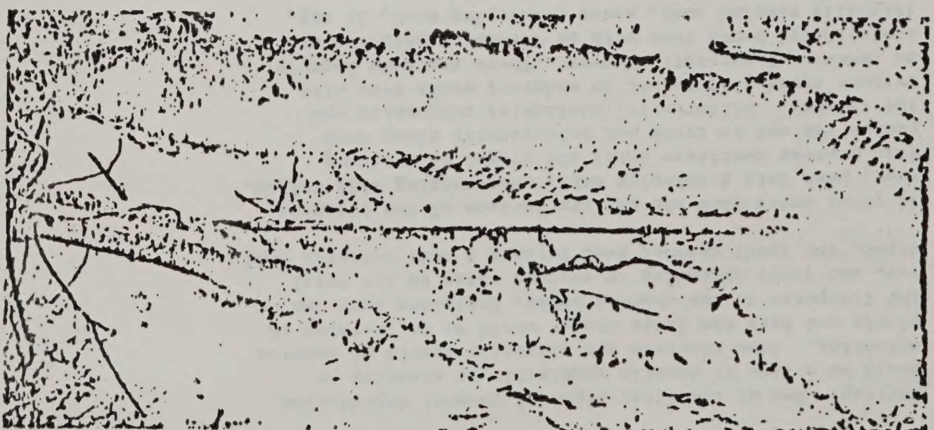
C. Obstructions and Flow Deflectors (Continued)

1. Excellent: Logs, rocks, and other obstructions to flow are firmly embedded and produce a pattern of flow which does not erode the banks and bottom or cause sediment buildups. Poolriffle relationship stable.

2. Good: Obstructions to flow and sediment traps are present, causing cross currents which create some minor bank and bottom erosion. Some of the obstructions are newer, not firmly embedded and move to new locations during high flows. Some sediment is trapped in pools decreasing their capacity.

3. Fair: Moderately frequent and quite often unstable obstructions, cause noticeable seasonal erosion of the channel. Considerable sediment accumulates behind obstructions.

4. Poor: Obstructions and traps so frequent they are intervisible, often unstable to movement and cause a continual shift of sediments at all seasons. Since traps are filled as soon as formed, the channel migrates and widens.



Same location as shown on page 14, but looking upstream. Obstruction like this could become the nucleus of a debris jam.

Cutting and Deposition are concommittent processes. You can't have one without the other. However, it is possible for each to be taking place in different reaches of the same stream at the same time, and hence the separation for classification purposes which follows.

D. Cutting: One of the first signs of channel degradation would be a loss of aquatic vegetation by scouring or uprooting. Some channels are naturally devoid of aquatic plants and here the first stages would be an increase in the steepness of the channel banks. Beginning near the top, and later extending in serious cases to the total depth, the lower channel bank becomes a near vertical wall.

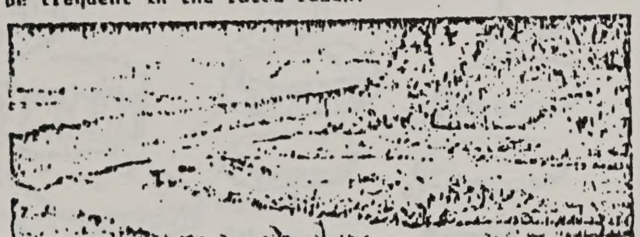
If plant roots bind the surface horizon of the adjacent upper bank into a cohesive mass, undercutting will follow. This process continues until the weight of overhang causes the sod to crack and subsequently slump into the channel. Differential horizontal compaction and texture could also result in undercut banks even with an absence of vegetative cover. There are some loosely consolidated banks that with or without vegetation are literally nibbled away, never developing much, if any, overhang.

1. Excellent: Very little or no cutting is evident. Raw, eroding banks are infrequent, short and predominately less than 6" high.

2. Good: Some intermittent cutting along channel outcurves and at prominent constrictions. Eroded areas are equivalent in length to one channel width or less and the vertical cuts are predominately less than 12".

3. Fair: Significant bank cutting occurs frequently in the reach. Raw vertical banks 12" to 24" high are prevalent as are root mat overhangs and sloughing.

4. Poor: Nearly continuous bank cutting. Some reaches have vertical cut faces over 2 feet high. Undercutting, sod-root overhangs and vertical side failures may also be frequent in the rated reach.



Poor bank conditions at this bend are evident.

E. Deposition: Lower bank channel areas are generally the steeper portions of the wetted perimeter and may be rather narrow strips of land that offer slight opportunity for deposition. Exceptions to this statement abound since deposition is often noted on the lea side of large rocks and log deflectors which form natural jetties. However, these deposits tend to be short and narrow. On the less steep, lower banks, deposition during recession from peak flows can be quite large. The appearance of sand and gravel bars where they did not previously exist may be one of the first signs of upstream erosion. These bars tend to grow, primarily in depth and length, with continued watershed disturbance(s). Width changes are in a shoreward direction as overflow deposition takes place on the upper banks. Dimensional deposition "growth" is limited by the size and orientation of the obstructions to flow along the channel banks, flow velocity and a continuing upstream sediment supply.

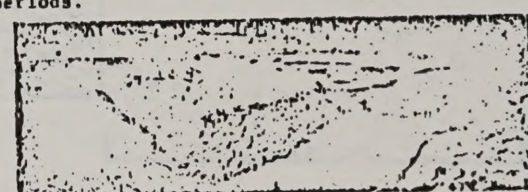
Deposition may also occur on the inside radii of bends, particularly if active cutting is taking place on the opposite shore. Also, deposits are found below constrictions or where there is a sudden flattening of stream gradient as occurs upstream above geologic nic points.

1. Excellent: Very little or no deposition of fresh silt, sand or gravel in channel bars in straight reaches or point bars on the inside banks of curved reaches.

2. Good: Some fresh deposits on bars and behind obstructions. Sizes tend to be predominately from the larger size classes - coarse gravels.

3. Fair: Deposits of fresh, coarse sands and gravels observed with moderate frequency. Bars are enlarging and pools are filling so riffle areas predominate.

4. Poor: Extensive deposits of predominately fresh, fine sands, some silts, and small gravels. Accelerated bar development common. Storage areas are now full and sediments are moving even during low flow periods.



Poor conditions are illustrated here.

III. Channel Bottom

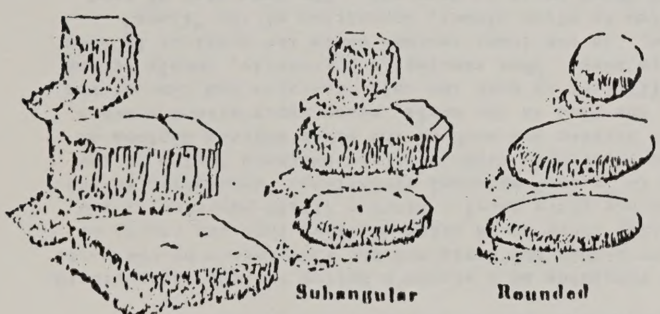
Water flows over the channel bottom nearly all of the time in perennial streams. It is, therefore, almost totally an aquatic environment, composed of inorganic rock constituents found in an infinite variety of kinds, shapes, and sizes. It is also a complex biological community of plant and animal life. This latter component is more difficult to discern and may in fact, at times and places, be totally lacking.

Both components, by their appearance alone and in combination, offer clues to the stability of the stream bottom. They are arbitrarily separated and individually rated for convenience and emphasis during the evaluation process. Because of the high reliance on the visual sense, inventory work is best accomplished during the low flow season and when the water is free of suspended or dissolved substances. If ratings must be made in high flow periods, sounds of movement may be the only clue as to the state of flux on the bottom.

A. Angularity: Rocks from stratified, metamorphic formations break out and work their way into channels as angular fragments that resist tumbling. Their sharp corners and edges wear and are rounded in time, but they resist the tumbling motion. These angular rocks pack together well and may orient themselves like shingles (imbricated). In this configuration they are resistant to detachment.

In contrast, igneous rocks often produce fragments that round up quickly, pack poorly and are easily detached and moved downstream.

Excellent to Poor ratings relate to the amount of rounding exhibited and, secondarily, the smoothness or polish the surfaces have achieved. Some rocks never do smooth up in the natural environment, but most round up in time. Both conditions, of course, are relative within the inherent capability of the respective rock types.



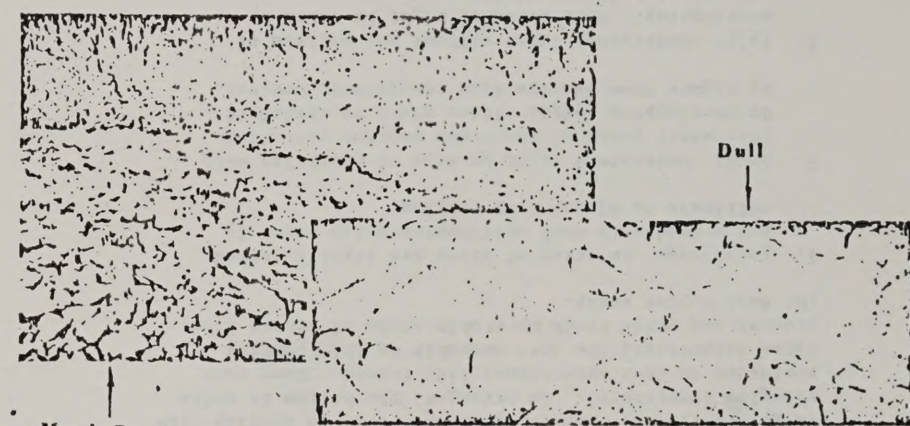
B. Brightness: Rocks in motion "gather no moss", algae or stain either. They become polished by frequent tumbling and, as a general rule, appear brighter in their chroma values than similar rocks which have remained stationary. The degree of staining and vegetative growths relate also to water temperature, seasons, nutrient levels, etc. In some areas a "bright" rock will be "dulled" in a matter of weeks or months. In another it may take years to achieve the same results. Nevertheless, even slight changes during the spring runoff should be detectable during the next summer's survey. Look first for changes in the sands and gravels.

1. Excellent: Less than 5% of the total bottom should be bright, newly polished and exposed surfaces. Most will be covered by growths or a film of organic stain. Stains may also be from minerals dissolved in the water.

2. Good: 5 to 35% of the bottom appears brighter, some of which may be on the larger rock sizes.

3. Fair: About a 50-50 mixture of bright and dull with a 15% leeway in either direction (i.e., a range of from 35 to 65% bright materials).

4. Poor: Bright, freshly exposed rock surfaces predominate with two-thirds or more of the bottom materials in motion recently.



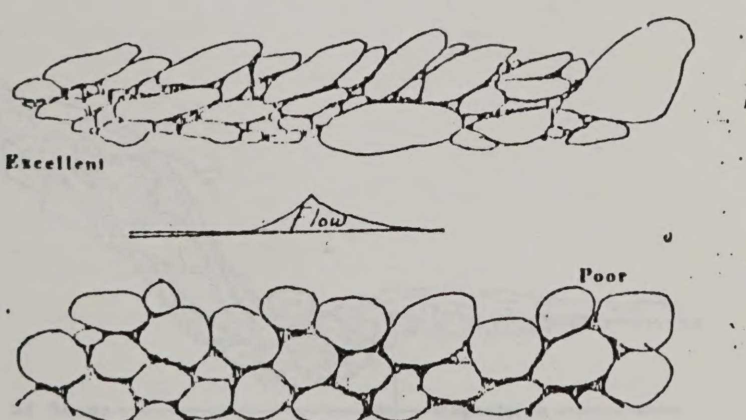
C. Consolidation (Particle Packing): Under stable conditions, the array of rock and soil particle sizes pack together. Voids are filled. Larger components tend to overlap like shingles (imbricate). So arranged, the bottom is quite resistent to even exceptional flow forces. Some rock types (granitics) are less amenable to this packing process and never reach the stable state of others like the Belt Series rocks.

1. Excellent: An array of sizes are tightly packed and wedged with much overlapping which makes it difficult to dislodge by kicking.

2. Good: Moderately tight packing of particles with fast water parts of the cross section protected by overlapping rocks. These might be dislodged by higher than average flow conditions, however.

3. Fair: Moderately loose without any pattern of overlapping. Most elements might be moved by average high flow conditions.

4. Poor: Rocks in loose array, moved easily by less than high flow conditions and move underfoot while walking across the bottom. The shape of these rocks tends to be predominantly round and sorted so that most are of similar size.



Side Views of Substrate

D. Bottom Size Distribution and Percent Stable Materials:

Rocks remaining on a stream's bottom reflect the geologic sources within the basin and the flow forces of the past. Normally, there is an array of sizes that you expect to see in any given local. After a little experience, you begin to "sense" abnormal situations. Generally, in the mature topography typical of the Northern Region of the Forest Service and much of the other western Regions as well, the flow in the small, steep upper stream reaches is sufficient to wash the soil separates and some of the gravels away. What remains is a gravelly, cobbly stream bottom. In the lower reaches where the gradient is less and flow is often slower, deposition of the "fines" eroded above begin to drop out. The separates of sand, silt, and some clay begin to cover the coarser elements. Except where trapped in still water areas, these fines tend to be in constant motion to ever lower elevations.

Two elements of bottom stability are rated in this item: (1) Changes or shifts from the natural variation of component size classes and (2) the percentage of all components which are judged to be stable materials. Bedrock, large boulders, and cobble stones ranging in size from one to three feet or more in diameter are considered "stable" elements in the average situation. Obviously, smaller rocks in smaller channels might also be classed as stable. The sizes are given only to guide thought. Bedrock as a major component of bottom and banks, no matter what size the channel or how the other elements rate, always results in an excellent classification of that reach.

1. Excellent: There is no noticeable change in size distribution. The rock mixture appears to be normal for the kind of geologic sources in the basin and the flow forces of streams of this size and location in the watershed.

   If a shift or change has taken place so there are greater percentages of large rock in the small streams and smaller sizes in large streams, the condition class most appropriate should be checked. It is a matter of degree as follows:

   (Stable Materials 80-100%).

2. Good: Slight shift in either direction.

   (Stable Materials 50-80%).

3. Fair: Moderate shift in size classes.

   (Stable Materials 20-50%).

4. Poor: Marked, a pronounced shift.

   (Stable Materials less than 20%).

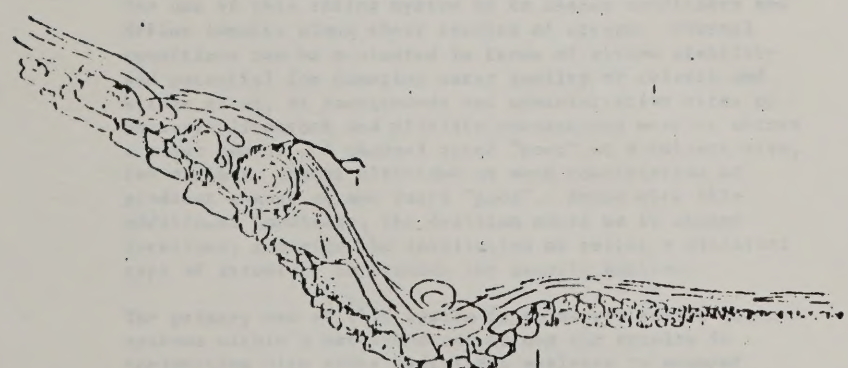
E. Scouring and/or Deposition: Items of size, angularity and brightness already rated above should lead you to some conclusions as to the amount of scouring and/or deposition that is taking place along the channel bottom.

1. Excellent: Neither scouring or deposition is much in evidence. Up to 5% of either or a combination of both may be present along the length of the reach; i.e., 0-5 feet in 100 feet of channel length.

2. Good: Affected length ranges from 5 to 30%. Cuts are found mostly at channel constrictions or where the gradient steepens. Deposition is in pools and backwater areas. Sediment in pools tends to move on through so pools change only slightly in depth but greatly in composition of their size classes.

3. Fair: Moderate changes are occurring. 30 to 50% of the bottom is in a state of flux. Cutting is taking place below obstructions, at constrictions and on steep grades. Deposits in pools now tend to fill the pool and decrease their size.

4. Poor: Both cutting and deposition are common; 50% plus of the bottom is moving not only during high flow periods but at most seasons of the year.



Zone of Scour ——— Deposition

F. Aquatic Vegetation: When some measure of stabilization of the soil-rock components is achieved, the channel bottom becomes fit habitat for plant and animal life. This process begins in the slack water areas and eventually may include the swift water portions of the stream cross section. With a change in volume of flow and/or sedimentation rates, there may also be a temporary loss of the living elements in the aquatic environment. This last item attempts to assess the one macro-aquatic bio-mass indicator found to best express a change in channel stability.

Clinging Moss and Algae: These lower plant forms do not have roots but cling to the substrate. They are low growing and may first appear as a green to yellow-green slick spot on the bottom rocks. Moss plants continue with slight variation in color but no great change in mass form season to season. Algae by contrast have a peak of growth activity and then die off in great numbers. The slippery conditions they produce persist after death, however.

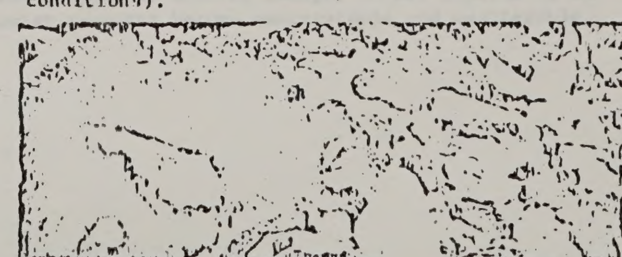
Both algae and moss inhabit the swift water areas as well as the quiet pools and backwater portions of the stream bottom.

1. Excellent: Clinging plants are abundant throughout the reach from bank to bank. A continuous mat of vegetation is not required but moss and/or algae are readily seen in all directions across the stream.

2. Good: Plants are quite common in the slower portions of the reach but thin out or are absent in the swift flowing portions of the stream.

3. Fair: Plants are found but their occurrence is spotty. They are almost totally absent from rocks in the swifter portions of the reach and may also be absent in some of the slow and still water areas.

4. Poor: Clinging plants are rarely found anywhere in the reach. (This is an unusual situation but could happen under a combination of adverse environmental conditions).



Channels with this much moss are rated "Excellent"

Management Implications

After beating the brush, getting your feet wet and fighting insects, you have established a series of channel ratings. You may now ask, "What do these numbers mean and how are they used in making a management decision?".

By now you know this subject is complicated and precludes indepth answers here. The following brief answers may satisfy you or they may raise more questions. When this happens, it's time to consult your Forest hydrologist for detailed, specific answers.

The numbers and the adjective ratings they relate to mean what they say. A stream channel reach that rates "poor" has a combination of attributes that will require more judicious upstream management of the tributary watershed lands than one rated "excellent". This rating procedure was not designed to fix blame for poor land and water management or to reward good management, although, in time, it could be used for this purpose. Before passing judgment, be aware that natural, undisturbed watersheds may exhibit poor hydrologic conditions. Conversely, a highly developed and used watershed may have a drainage network in good hydrologic shape. The rating system will therefore have the most value to land managers who have definite water management goals, who can relate these to impacts of other resource uses and activities, who understand natural limitations, and are willing and able to use the system to define the risks they are willing to take to maintain or alter the status quo.

One use of this rating system is to assess conditions and define impacts along short reaches of stream. Channel conditions can be evaluated in terms of stream stability and potential for damaging water quality at culvert and bridge sites, at campgrounds and administrative sites or wherever livestock and wildlife concentrate near or across a water course. A channel rated "poor" at a culvert site, for example, cannot withstand as much constriction or gradient change as one rated "good". Armed with this additional knowledge, the decision could be to change locations, redesign the intallation or select a different type of structure to protect the aquatic habitat.

The primary use of this system is to assess entire channel systems within a watershed and to use the results in conjunction with other hydrologic analyses to augment silvicultural prescriptions. Rapid changes in the density and areal extent of vegetation on a watershed can increase stream discharges. Channel systems rated "excellent"

App. VII, 12

can withstand these increases with less damage than systems rated "poor". "Poor" systems can withstand gradual changes better than abrupt changes in the discharge regimen.

To calculate an overall rating for a stream system, (1) multiply the length of each reach by its numeric rating, (2) add the weighted products of all reaches in the system and (3) divide by the total length of the system.

For example:

Reach A	:	3.2 miles x 80 (fair)	= 256
Reach B	:	0.5 miles x 100 (poor)	= 50
Reach C	:	2.0 miles x 40 (good)	= 80
Total	:	5.7 miles	386

Stream system average: 386 ÷ 5.7 = 68 (Good)

Land and water should not be managed on the basis of averages. In the above example, the stream system is composed of three reaches which rate "good" on the average, but a "weak link" has been identified. Reach B is in "poor" condition. One of the obvious uses of this system is to identify "weak links" and to discover what, if any, opportunity exists to correct the condition. It matters little if the damaged area is natural or man-caused. The discovery of "weak links" should reasonably alter upstream land management to the extent necessary to achieve stated land and water management objectives.

The procedures should ultimately serve as a check and a measure of management success. The net effects of each new increment of change within the watershed management unit will ultimately be expressed in the condition of the stream channel responding to a new hydraulic regimen. Prudent managers will seek these trend data by periodic reappraisal of channel conditions and respond to adverse changes before impacts to the water resource become unacceptable and unalterable.

APPENDIX VIII

STREAM BANK DAMAGE/EROSION EVALUATION

The accomapnying form is used to indicated the extent of bank instability and erosion areas. For each cause of instability, the distance, in feet or meters, of the disturbed bank is recorded. Totals are then given for each section or reach. The total may be by causative agent, or a total for all agents, or both; the value selected is so indicated. With the length of the inventory section or reach known, percentages of bank instability can then be caluculated both for totals and by type of causative agent.

While not included on this form, the area of disturbance can also be caluculated. If the dimensions, both length and height, of the disturbance is recorded, then the areal extent of the instability can be indicated for each type of activity. Providing site referencing for instability areas will permit locating these areas within an inventory section or reach as well as providing summaries of instabiltiy for the reach or section as a whole.

STREAM BANK DAMAGE/EROSION EVALUATION

Stream ____________ Ident. Code No. ________ Distance Surveyed ________

Surveyor(s) ______________________ Date ____________

Type and Amount of Bank Damage		Stream Banks (Looking Upstream)		
Type	Amount	Right	Left	Total
Natural	Linear Feet (Percent)			
Logging	Linear Feet (Percent)			
Road	Linear Feet (Percent)			
Livestock	Linear Feet (Percent)			
Big Game	Linear Feet (Percent)			
Recreation	Linear Feet (Percent)			
Other (Specify)	Linear Feet (Percent)			
Totals	Linear Feet (Percent)			

Comments:

APPENDIX IX

INSTREAM FLOW MEASUREMENTS

Two techniques are included in this appendix. Both involve using a device to determine the velocity of flow. The area of a stream cross-section is measured, then multiplied times the velocity to determine the volume of flow. In practice, a uniform section of stream is selected. The width of the stream is measured, then depth profiles are made, usually at one foot or one meter intervals. Then, using a head rod or a current meter, the velocity of the stream is determined at the same location. Since the current varies acrossed a stream, the velocity is dtermined at selected points, normally the same points as the depth profile. The actual volume of flow is then a summation of the individual areaxvelocity measurements.

DISCHARGE MEASUREMENT RECORD
Velocity - Head Rod Method
Forest Service - Pacific Northwest Region

Forest ______________
W/S No. ______________
Compiled By ______________
Checked By ______________

District ______________ Drainage ______________ Station No. ______________
Turpidity (ppm) ______________ Date ______________ Discharge ______________ cfs
Party ______________ Gage Height * ______________ Air ________ °F@ ____ Water ________ °F@ ____
Peak Gage Height ______________ Date of Occurence ______________

(1) Distance From Initial Point	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
		Depth		Velocity				Constants**	
	Width	Stream	Hydraulic Jump	h	v	Area	Discharge	h	v
								.01	.80
								.02	1.13
								.03	1.39
								.04	1.60
								.05	1.79
								.06	1.96
								.07	2.12
								.08	2.2[illegible]
								.09	2.41
								.10	2.54
								.11	2.65
								.12	2.78
								.13	2.89
								.14	3.00
								.15	3.11
								.16	3.21
								.17	3.[illegible]
								.18	3.40
								.19	3.50
								.20	3.59
								.25	4.01
								.30	4.39
								.35	4.74
								.40	5.07
								.45	5.38
								.50	5.67
								.55	5.95
								.60	6.21
								.65	6.47
								.70	6.71
								.75	6.95
								.80	7.17
								.85	7.39
								.90	7.61
								.95	7.82
								1.00	8.02
								1.10	8.[illegible]
								1.20	8.79

	(9) Constants ** h	(10) v
	1.30	9.14
	1.40	9.49
	1.50	9.82
	1.60	10.14
	1.70	10.46
	1.80	10.76
	1.90	11.05
	2.00	11.34
	2.20	11.90
	2.50	12.68

** $v = 8.02\sqrt{h}$ Where 'h' is the velocity head and 'v' is velocity in ft. per sec.

* Gage Height - Measurement after gage is tripped (present water level).

EXAMPLES OF COMPUTATIONS

width = $\frac{\text{3rd reading minus beginning from Column (1)}}{2}$

or width = $\frac{\text{4th reading minus 2nd reading}}{2}$

stream depth = head rod reading narrow edge

stream jump = head rod reading wide edge

'h' = jump - stream depth

'v' = from "constant" table

area = width x stream depth, of Column (2) x (3)

discharge = velocity x area, or Column (6) x (7)

Take minimum of 10 readings or approximately at 1½ to 2-foot intervals across stream along same line each time.

Gage Height - Measurement after gage is tripped (present water level).

Peak Height - Measurement before gage is tripped. (Height water has reached since last measurement).

9-275G
(Mar. 1972)

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

DISCHARGE MEASUREMENT NOTES

Meas. No. ....
Comp. by ....
Checked by ....

Sta. No. ....

....

Date ...., 19...... Party ....

Width .... Area .... Vel. .... G. H. .... Disch. ....

Method .... No. secs. .... G. H. change .... in .... hrs. Susp. ....

Method coef. .... Hor. angle coef. .... Susp. coef. .... Meter No. ....

GAGE READINGS				
Time		Recorder	Inside	Outside
Weighted M. G. H.				
G. H. correction				
Correct M. G. H.				

Type of meter ....

Date rated .... for rod, other.

Meter.................. ft. above bottom of weight.

Spin before meas. .... after ....

Meas. plots ..... % diff. from rating ....

Wading, cable, ice, boat, upstr., downstr., side

bridge .... feet, mile, above, below

gage, and ....

Check-bar, found ....

changed to .... at ....

Correct ....

Levels obtained ....

Measurement rated excellent (2%), good (5%), fair (8%), poor (over 8%), based on following conditions: Cross section ....

Flow .... Weather ....

Other .... Air ....°F@ ....

Gage .... Water ....°F@ ....

.... Record removed .... Intake flushed U/L ....

Observer ....

....

Control ....

....

Remarks ....

....

....

G. H. of zero flow .... ft.

.0 .10 .20 .30 .40 .50 .60 .70 .75

River at—

Angle coefficient	Dist. from initial point	Width	Depth	Observation depth	Revolutions	Time in seconds	VELOCITY		Adjusted for hor. angle or	Area	Discharge
							At point	Mean in vertical			
⊙											

.80 .85 .90 .92 .94 .96 .97 .98 .99 1.00 .99 .98 .97 .96 .94 .92 .90 .85 .80

.0 .10 .20 .30 .40 .50 .60 .70 .75

APPENDIX X

KUCHLER PHYSIOGRAPHIC REGIONS

Following are the physiographic regions as outlined by Kuchler. These are recommended for use in describing the general vegetative region in which the inventory stream is located.

Note: Physiographic Regions are followed by their respective two-digit codes (in parentheses); Associations are preceded by their respective three-digit codes.

Northern Pacific Border Physiographic Region (01)

001 Spruce - cedar - hemlock forest (Picea - Thuja - Tsuga)

002 Cedar - hemlock - Douglas-fir forest (Thuja - Tsuga - Pseudotsuga)

004 Fir - hemlock forest (Abies - Tsuga)

006 Redwood forest (Sequoia - Pseudotsuga)

015 Western spruce - fir forest (Picea - Abies)

026 Oregon oakwoods (Quercus)

028 California mixed evergreen forest (Quercus - Arbutus - Pseudotsuga)

034 Montana chaparral (Arctostaphylos - Castauopsis - Ceanothus)

047 Fescue - oatgrass (Festuca - Dauthonia)

052 Alpine meadows and barren (Agrostis - Carex - Festuca - Poa)

Cascade Mountains Physiographic Region (02)

002 Cedar - Hemlock - Douglas-fir forest (Thuja - Tsuga - Pseudotsuga)

003 Silver fir - Douglas-fir forest (Abies - Pseudotsuga)

004 Fir hemlock forest (Abies - Tsuga)

014 Grand fir - Douglas-fir forest (Abies - Pseudotsuga)

015 Western spruce - Fir forest (Picea - Abies)

052 Alpine meadows and barren (Agrostis - Carex - Festuca - Poa)

Southern Pacific Border Physiographic Region (3)

006 Redwood forest (Sequoia - Pseudotsuga)

009 Pine cypress forest (Pinus - Cupressus)

030 California oakwoods (Quercus)

033 Chaparral (Adenostoma - Arctostaphylos - Ceanothus)

035 Coastal sagebrush (Salvia - Eriogonum)

FISHERIES HABITAT INTENSIVE MONITORING FORM

The following code lists will be the final ones placed in the computer when the Coos Bay District completes its' programing. Any change in these codes can be made with the help of your own programer. We have reached the point of diminishing returns on this form and in my estimate I don't want to make any more changes until field testing shows that it is necessary.

POOL TYPE & CODE:
Z= N/A
S = Secondary Channel
B = Backwater
T = Trench
P = Plunge
L = Lateral Scour
G = Slough
E = Eddy
D = Dammed
- Z = N/A
- W = Large Woody
- B = Beaver
- D = Debris Torrent
- G = Enhancement Structure
- O = Other Human

The following have no additions to the form you were given at the Eugene meeting:

Pool caused by:
Riffle type & code:
Vegetation type & code:

FISH SPECIES & CODE:

A = Coho-0
B = Trout sp.-0
C = Steelhead 1+
D = Cutthroat 1+
E = Redside Shiner
F = Dace
G = Chinook
H = Coho 1+
I = Steelhead 2+
J = Cutthroat 2+
K = Sculpin
L = Other

John W. Anderson

FISHERIES-HABITAT INTENSIVE MONITORING FORM

1. Stream Name ______________________ 2. Stream order __________ 3. Stream Reach ______________
4. Basin Area ___________ acres 5. Date___/___/______

6. Habitat type (____)Code ← P = Pool — R = Riffle — G = Glide
7. Length (____)Ft.
8. Width (____)Ft.
9. Av. Depth (____)Ft.
10. Max Depth (____)Ft.
11. Pool type (____)Code
12. Dammed type(____)Code
13. Pool caused by (____)Code
14. Diam./wood causing pool #13. (____)in.
15. Riffle Type (____)Code

POOL TYPE & CODE:
- Z = N/A
- G = Slough
- S = Secondary Channel
- E = Eddy
- B = Backwater
- T = Trench
- P = Plunge
- L = Lateral Scour
- D = Dammed
  - Z = N/A
  - O = Other Human
  - W = Large Woody
  - B = Beaver
  - D = Debris Torrent
  - G = Enhancement Structure

POOL CAUSED BY:
- B = Boulder
- W = Large Wood
- E = Enhancement Structure
- D = Beaver Dam
- C = Culvert
- F = Falls
- R = Stream Bend
- U = Other

RIFFLE TYPE & CODE:
- Z = N/A
- S = Secondary Channel
- B = Lo Gradient - Bedrock
- G = Lo Gradient - Gravel
- C = Lo Gradient - Cobble
- L = Lo Gradient - Boulders
- R = Rapids
- F = Cascades

IN-STREAM COVER CHARACTERISTICS

16. Turbulence (____)Sq. Ft.
17. Undercut banks (____)Sq. Ft.
18. Woody cover (____)Sq. Ft.
19. Overhanging veg.(____)Sq. Ft.
20. Deep pool (____)Sq. Ft.
21. Boulder edge (____)Lin. Ft.
22. Large woody edge(____)Lin. Ft.
23. Gabion/other " (____)Lin. Ft.
24. Bottom ledge (____)Lin. Ft.

STREAM SUBSTRATE COMPOSITION

25. Large Boulder(____)%
26. Small Boulder(____)%
27. Cobble (____)%
28. Rubble (____)%
29. Large gravel (____)%
30. Small gravel (____)%
31. Sand (____)%
32. Silt (____)%
33. Woody (____)%
34. Bedrock (____)%

RIPARIAN ZONE MEASUREMENTS

35. Stem Diam. (____)in.
36. Age (5 yr. incr.)(____)years
37. Shade percent (____)%
38. Main veg. type (____)Code
39. Sec. veg. type (____)Code
40. Sec. veg. type (____)Code
41. Sec. veg. type (____)Code

VEGETATION TYPE & CODE

Tree species
- D = Douglas fir
- H = Hemlock western
- C = Western red cedar
- WF = Grand Fir
- M = Bigleaf maple
- MY = Myrtle
- RA = Red alder
- W = willow

Brush species
- SB = Salmonberry
- TB = Thimbleberry
- VM = Vine maple
- BC = Black currant

FISH POPULATION CHARACTERISTICS

Species	Population	$\overline{X}$ Weight (g)	$\overline{X}$ Length (mm)	Pass 1	Pass 2
42.	43.	44.	45.		
46.	47.	48.	49.		
50.	51.	52.	53.		
54.	55.	56.	57.		
58.	59.	60.	61.		
62.	63.	64.	65.		

FISH SPECIES & CODE:
- A = Coho-0
- B = Trout sp.-0
- C = Steelhead 1+
- D = Cutthroat 1+
- E = Redside Shiner
- F = Dace
- G = Chinook
- H = Coho 1+
- I = Steelhead 2+
- J = Cutthroat 2+
- K = Sculpin
- L = Other

FISHERIES HABITAT EXTENSIVE MONITORING FORM

Stream Name: ______________________ Stream Order: ______________ Reach: __________

Reach Length: ______________________ Date: ___/___/___ Sampler's Name: ______________

Habitat Code	Type Code	Structural Assoc. Code	Length	Width	Depth	Maximum Depth

HABITAT CODE:

P = Pool
R = Riffle
G = Glide

TYPE CODE:

POOL
S = Secondary Channel
B = Backwater
T = Trench
P = Plunge
L = Lateral Scour
D = Dammed
G = Slough
E = Eddy

RIFFLE
S = Secondary Channel
B = Bedrock
G = Gravel
C = Cobble
B = Boulder
R = Rapids
F = Cascades

STRUCTURAL ASSOCIATION CODE:

B = Boulder
W = Large Wood
E = Enhanced Structure
D = Beaver Dam
C = Culvert
F = Falls
R = Stream-bend
U = Other

CONTINUATION SHEET

Page ____ of ____
Stream Name: ____________
Stream Reach: ____________

Fisheries Habitat Extensive Monitoring Form

Habitat Code	Type Code	Structural Assoc. Code	Length	Width	Depth	Maximum Depth

HABITAT CODE:

P = Pool
R = Riffle
G = Glide

TYPE CODE:

POOL	RIFFLE
S = Secondary Channel	S = Secondary Channel
B = Backwater	B = Bedrock
T = Trench	G = Gravel
P = Plunge	C = Cobble
L = Lateral Scour	B = Boulder
D = Dammed	R = Rapids
G = Slough	F = Cascades
E = Eddy	

STRUCTURAL ASSOCIATION CODE:

B = Boulder
W = Large Wood
E = Enhanced Structure
D = Beaver Dam
C = Culvert
F = Falls
R = Stream-bend
U = Other

FISHERIES-HABITAT INTENSIVE
MONITORING FORM GUIDELINES

1. Stream Name: Fly Creek
2. Date: 6-29-83
3. Reach: Any designation alphabetic or numeric
4. Stream Order: Stream order is based upon Strahler (1957). See BLM URA/MFP maps
5. Basin area_____Acres: Area should be calculated using a planimeter or dot grid
6. Habitat type: Enter correct code for Pool, Riffle or Glide
7. Length: Enter mean length in feet
8. Width: Enter mean width in feet
9. Av. Depth: Enter mean depth
(The mean length, width, depth should be determined by taking at least three (3) measurements of each.
10. Maximum Depth: Measure the deeps water in the habitat type
11. Pool type: Enter the appropriate pool type code.

Z = N/A use this code if the habitat type in #6. is not a pool

S = Secondary Channel pools

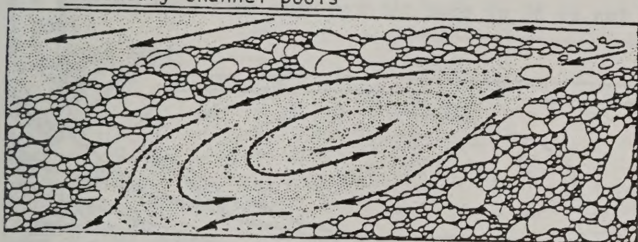


Figure 1. Secondary Channel Pool.

Secondary channel pools (Fig. 1) are those that remained within the bankful margins of the stream after freshets. During the survey period (June-Sept.) most of thse pools will disappear, and those remaining have little flow through them. Secondary channel pools are usually associated with gravel bars, but many conatained sand and silt substrates.

B = Backwater Pool

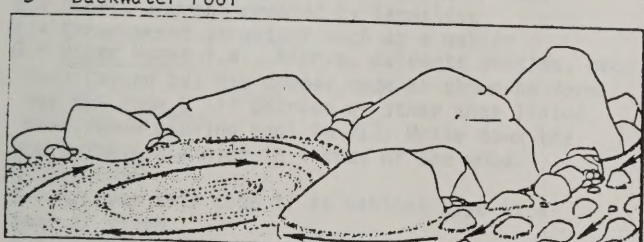


Figure 2. Backwater pool associated with boulders

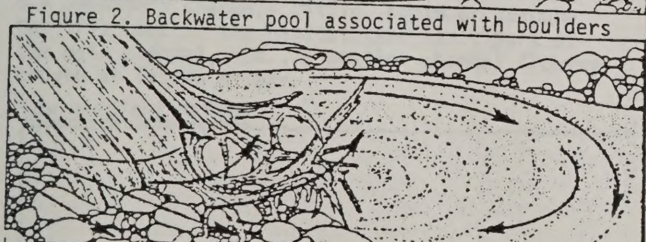


Figure 3. Backwater pool associated with rootwad.

Figure 4. Backwater pool associated with large debris

Backwater pools (Figs. 2-4) are found along channel margins and are caused by eddies behind large obstructions such as rootwads or boulders. This pool type is often quite shallow (30 cm) and tends to be dominated by fine-grained substrates. Like secondary channel pools, backwater pools possess current velocities that are very low.

T = Trench pool

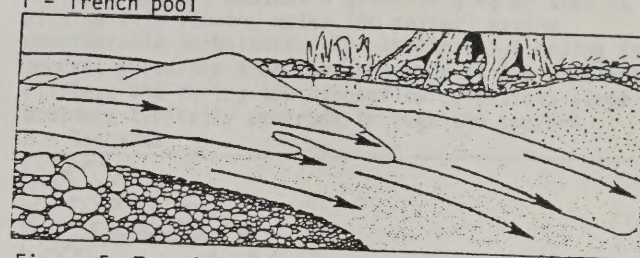


Figure 5. Trench Pool Associated with Bedrock.

Trench pools (Fig. 5) are long, generally deep slots in a stable substrate. Channel cross sections are typically U-shaped with a coarse-grained bottom flanked by bedrock walls. Current velocities in trench pools are the swiftest of any pool type and the direction of flow is most uniform.

P = Plunge Pool

Figure 6. Plunge Pool Associated with Large Debris.

Plunge pools (Fig. 6) occur where the stream passes over a complete or nearly complete channel obstruction and drops vertically into the streambed below, scouring out a depression. This pool type is often large, quite deep (1 m), and possess a complex flow pattern radiating from the point of water entry. Substrate particle size is also highly variable.

L = Lateral Scour Pool

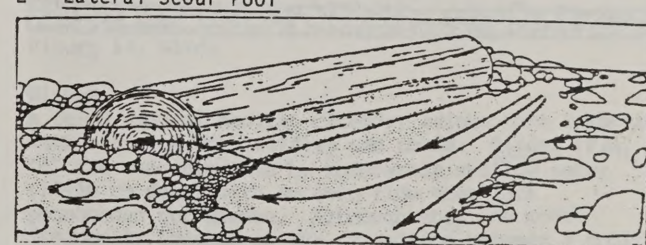


Figure 7. Lateral Scour Pool Associated with Large Debis.

G = Slough pools are usually long arms often associated with side channels. Flow through these areas may occur only during peak periods and little or no current is present during most of the year.
E = Eddy pools are charaterized by a rapidly circulating current that often traps floating debris and creates a deep pool. They are often found to one side of the base of cascades or rapids out of the main flow

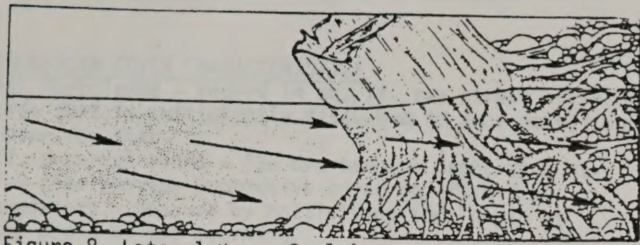


Figure 8. Lateral Scour Pool Associated with Rootwad.

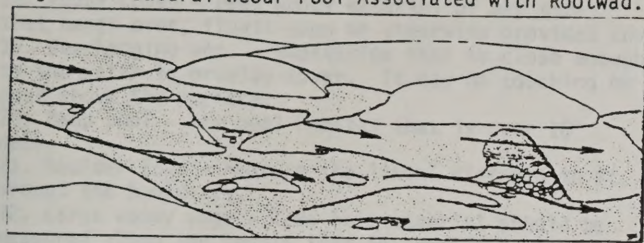


Figure 9. Lateral Scour Pool Associated with Bedrock.

Lateral scour pools (Figs. 7-9) differ from plunge pools in that the flow is directed to one side of the stream by a partial channel obstruction. Often an undercut bank is associated with this pool type.

12. Dammed type: Enter proper dammed code
 Z = N/A use this code when habitat type in #6 is not a pool
 W = Large Woody

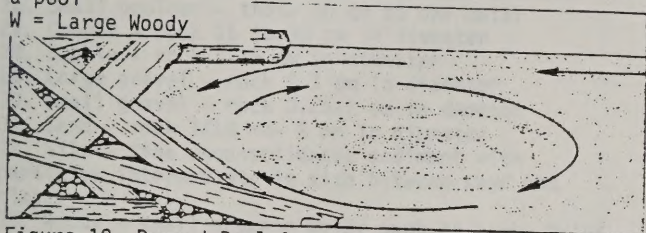


Figure 10. Dammed Pool Associated with Large Debris.

Dammed pools (Fig. 10) consist of water impounded upstream from a complete or nearly complete channel blockage. Typical causes of dammed pools are debris jams, rock landslides, or beave dams. Depending upon the size of the blockage, dammed pools can be very large. Water velocity in this pool type is characteristically low and sbstrates tend toward smaller gravels and sand.
 B = Beaver Pool created behind a beaver dam.
 D = Debris Torrent created by landslide
 G = Enhancement structure such as a gabion
 O = Other Human i.e., Riprap, culverts Jetties, etc.

13. Pool Caused by: Use proper code as shown on form. Use the code U if unknown or other than listed.
14. Diam./wood causing pool in #13: Write down the approximate diameter in inches of the wood.
15. Riffle Type
 Z = N/A use this code if #6 habitat type is a pool or glide.
 S = Secondary Channel- riffle, rapid or cascade Use this code if the habitat type isn't part of the main channel, i.e., a smaller channel flowing around an island or bar.

Low gradient riffle

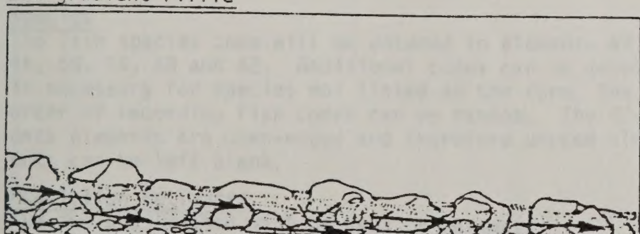


Figure 11. Low gradient riffle

Low gradient riffles (fig. 11) are shallow (20 cm deep) stream reaches with moderate current velocity (20-50 cm/sec) and moderate turbulence. Substrate is usually composed of gravel, pebble, and cobble-sized particles (2-256 mm). An upper gradient limit for this habitat type is arbitrarily set at 4%.

B = Low gradient with bedrock substrate
G = Low gradient with gravel substrate
C = Low gradient with cobble substrate
L = Low gradient with boulder substrate
R = Rapids

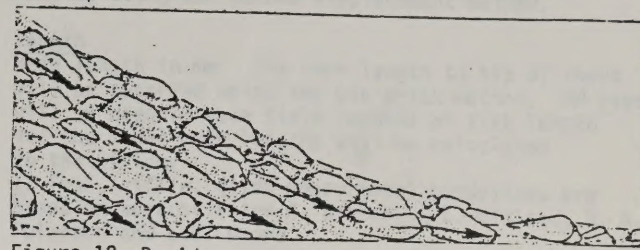


Figure 12. Rapids

Rapids (Fig. 12) possess a gradient greater than 4% with swiftly flowing water (50 cm/sec) having considerable turbulence. The substrate of rapids is generally coarser than the substrate of low gradient riffles, and during low streamflow conditions large boulders typically protrude through the surface
F = Cascades

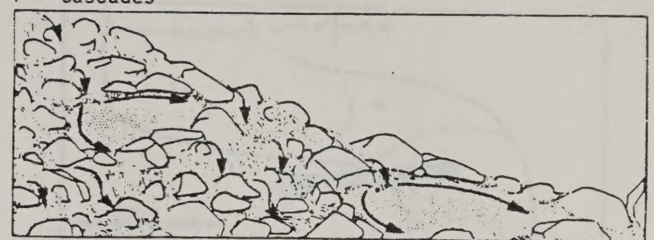


Figure 13. Cascade

Cascades (Fig.13.), the third type of riffle habitat, is the steepest. Unlike rapids, which have an even gradient, cascades consist of a series of small steps of alternating small waterfalls and shallow pools. The usual substrate of cascades is bedrock or an accumulation of boulders; however, this habitat type is occasionally found on the downstream face of woody debris dams.

G = Glide

The Glide code is used in element #6.

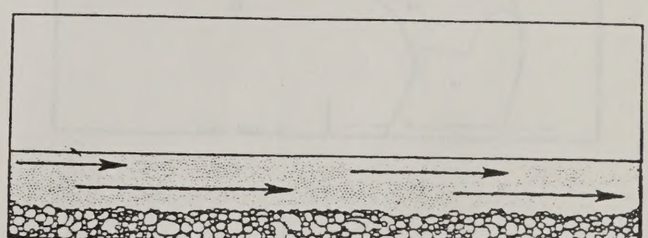


Figure 14. Glide

Glides
A third general habitat category exists that possess attributes of both riffles and pools. Glides (Fig. 14) are characterized by moderately shallow water (10-30 cm deep) with an even flow that lack pronounced turbulence. Although they are most frequently located at the transition between a pool and head of a riffle, glides are occasionally found in long, low gradient stream reaches with stable banks and no major flow obstructions. The typical substrate is gravel and cobbles. The term 'run' has been applied to this habitat type, but we feel that the designation 'glide' is a more precise descriptor of the habitat conditions. Similar usage of the term has previously been adopted by Cuinat et al (1975) and Chapman and Knudsen (1980)

IN-STREAM COVER CHARACTERISTICS

16. Turbulence - record in sq. ft. any stream surface area that is sufficiently disturbed to provide hiding cover for fish
17. Undercut banks - The overhanging banks that at low flow provide protective cover for fish from predators. Measure by multiplying the length by the depth of the overhang.
18. Woody Cover - Dead woody material of any size that hangs over, floats upon or otherwise provides cove
19. Overhanging veg. - Vegetation that is close enough to the water to provide cover. It may be touching or just above the surface.
20. Deep pool - Any pool habitat that is over 18" deep.
21. Boulder Edge - Measure the lineal diatance in ft. around the boulder/s.
22. Large woody edge - Tree bole material should be measured along the length that is providing cover.

23. Gabion edge - Measure the dege that is providing the cover used by fish.
24. Bottom ledge - Measure the length of the bedrock ledges providing cover.

STREAM SUBSTRATE COMPOSITION

25. Large Boulder - those over (1) meter diameter
26. Small boulder - those 30 cm to one meter
27. Cobble - rock 15 to 30 cm in diameter
28. Rubble - rock 7-15 cm in diameter
29. Large gravel - rock 2-7 cm in diameter
30. Small gravel - rock 0.25-2 cm in dameter
31. Sand - rock 1/16 mm- 2 mm in diameter
32. Silt - fine unconsolidated sediment with particles intermediate in size between sand and clay.
33. Woody - small organic mater such as bark, twigs and branches
34. Bedrock - Solid, base geologic parent material.

RIPARIAN ZONE MEASUREMENTS

35. Stem Diameter: Diam. at breast height in inches of the dominant tree species
36. Age: record in 5 year increments i.e. 25years
37. Shade %: Use dendrometer to calculate canopy %
38. Main veg. type: Dominant tree or shrub sp. code.
39.-41. Sec. veg.type: record sub-dominant sp ies in decending order.

FISH POPULATION CHARACTERISTICS

42.-65.
This section is to be used only for the fish captured in the habitat listed on lines 6 thru 41. No fish data from other reaches or habitat types should be recorded on the form.

Species

The fish species code will be entered in elements 42, 46, 50, 54, 58 and 62. Additional codes can be developed if necessary for species not listed on the form. The order of recording fish codes can be random. The 42-65 data elements are open-ended and therefore unused elements can be left blank.

Population Estimates

The two pass method will be used to estimate population. Record passes 1 and 2 in the appropriate blocks. The population estimate will be calculated using the method of (Carle and Strub 1978). A computer program for the HP 97 Calculator is available for this work.

Weight

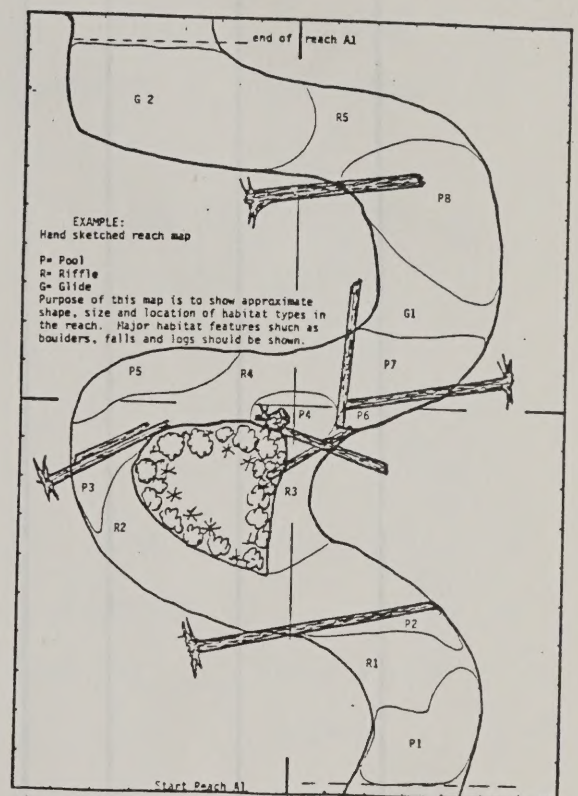
Mean weight in grams: These calculations will be made by using the volume displacement method.

Length

Mean length in mm: The fork length to tip of snout will be recorded using the pin prick method. MM paper will be used to make field records of fish length and the final mean lengths will be calculated in the office.

1/ Pool, riffle, glide measurement guidelines are based on work of Peter A. Bisson, J.L. Nielsen, R. A. Polmason and L.E. Grove.

1/ Pool, Riffle, Glide Measurement guidelines are based on work of Peter A. Bisson, J. L. Nielsen, R. A. Polmason and L. E. Grove



FISHERIES HABITAT EXTENSIVE MOINTORING FORM

Stream ________ Reach ________ Page ___ of ___

Date ________ Flow ________ Examiner ________ T ___ R ___ Sect ___

HABITAT CODE	POOL TYPE	SQUARE YDS SPAWNING GRAVEL	STRUCTURAL ASSOCIATION	LENGTH	MAX WIDTH	MEAN WIDTH	MAX. DEPTH	MEAN DEPTH	UNIT AGE CLASS	RIPARIAN TYPE & HT.	COMMENTS

HABITAT CODE
P-POOL R-RIFFLE U-RUN
G-GLIDE A-RAPID F-FALL
C-CASCADE

TYPE: L-LATERAL SCOUR E-EDDY
T-TRENCH P-PLUNGE D-DAMMED
S-SECONDARY CHANNEL G-SLOUGH
B-BACKWATER

STRUCTURAL ASSOCIATION
B-BOULDER W-LARGE WOODY F-FALLS
E-ENHANCEMENT STRUCTURE U-OTHER
D-BEAVER DAM C-CULVERT T-DEBRIS TORRENT S-STREAM BEND
N-CHANNEL CHANGE

RIPARIAN TYPE
A-ABSENT B-BUFFER
N-NONBUFFERED
C-CONIFEROUS
D-DECIDUOUS

STREAM INVENTORY

STREAM ________ TRIB ________ BASIN ________ REACH ________

STREAM ORDER ______ DATE ______ EXAMINER ________ T ____ R ____ SECT ____

HABITAT TYPE: POOL ___ RIFFLE ___ RAPID ___ GLIDE ___ RUN ___ CASCADE ___ FALL ___

WIDTH: MAX _____ MEAN _____ LENGTH: MAX _____ MEAN _____ DEPTH: MAX ____ MEAN ____

POOL TYPE: SECONDARY CHANNEL ____ BACKWATER ____ TRENCH ____ PLUNGE ____ EDDY ____

LATERAL SCOUR ____ SLOUGH ____ DAM ____

POOL FORMED BY: BOULDER ____ LARGE WOOD ____ BEAVER ____ FALLS ____ CULVERT ____

STREAM BEND ____ CHANNEL CHANGE ____ ENHANCEMENT ____ OTHER HUMAN ____

DEBRIS TORRENT ____ OTHER (SPECIFY) ________________

SUBSTRATE (IN %): BEDROCK ____ LARGE BOULDER (>3') ____ SMALL BOULDER (1-3') ____

COBBLE ____ RUBBLE ____ COARSE GRAVEL(1-3") ____ SMALL GRAVEL ____

SAND ____ SILT ____ WOODY MATERIAL ____

INSTREAM COVER: TURBULENCE ____ FT^2 UNDERCUT BANK ____ FT^2 WOODY COVER ____ FT^2

→ OVERHANGING VEG ____ FT^2 DEEP POOL ____ FT^2 BOULDER EDGE ____ FT

LARGE WOODY EDGE ____ FT BOTTOM LEDGE ____ FT MANMADE STRUCTURE ____ FT

WOODY MATERIAL: SIZE: LENGTHS ________ DIAMETERS ________ FT

TYPE: LARGE BOLES ____ SMALL BOLES ____ ROOT WAD ____ SMALL DEBRIS ____

DISTRIBUTION: SCATTERED ____ CLUMPED ____ JAM ____ UNIFORM ____

STREAMSIDE COVER: STEM DIAMETER ____ AGE ____ % SHADE ____ BUFFER PRESENT ____

MAIN VEG. TYPE ____ OTHER VEG. TYPE ________

____

FLOW _____ GRADIENT _____ VELOCITY _____ ____ CHANNEL/VALLEY PROFILE ____

SLOPE ANGLE: RIGHT ______ LEFT ______

INTRUSIONS ________________

RIPARIAN WIDTH: RT______ LEFT ______

EST. FISH POP, BY SPECIES ____________

____

COMMENTS: ____

RIPARIAN VEGETATION INVENTORY

STREAM ______________ TRIB ________________ BASIN _____________ DATE ______________

LOCATION ______________________________ T ____ R_____ SECT _______ EXAMINER_________

VEGETATIVE COMMUNITY ______________________ FLOW _____ EPHEMERAL ______ INTERMIT. ___

RIPARIAN WIDTH: LT ______ RT _______ TRANSITION ZONE WIDTH: LT ______ RT ___________

STREAM ORDER________ GRADIENT _______ INTRUSIONS ______________________________

WOODY SPECIES	NUMBER UNDER 4'	4-10	10-20	20-30	30-40	40-50	OVER 50	RELATIVE % OF PLANT COVER
SHRUBS								
FORBS								
GRASS/SEDGE								
BARE SOIL								
ROCK								
LITTER								
WOODY DEBRIS								

WOODY DEBRIS: LENGTH________ DIAMETER _______ ROT CLASS 1 2 3 4 5

BUFFERS: PRESENT______ ABSENT ______ COMPOSED OF: FULL______ PARTIAL____ HDWD____

SNAGS: HEIGHT_____ DBH____TOP: BROKEN___INTACT___ BARK: >50%___ <50%___ IN USE____

SNAG ROT CLASS 1 2 3 4 5 6 7 TIMBER VOLUME,BY SPECIES ____________________

% CANOPY CLOSURE: STREAM_____ RIPARIAN _____CANOPY DIST: SCATTERED CLUMPED UNIFORM CLOSED

SUCCESSION: 0-1 1-3 3-5 5-7 7-10 10-20 20-40 40-70 70-120 >120

OTHER VEGETATIVE SPECIES ____

____

EROSION AREAS ____

____

SIDE CHANNELS, OTHER FEATURES ____

____

COMMENTS ____

____

FISHERIES HABITAT EXTENSIVE MOINTORING FORM

Stream ______________ Reach ______________ Page ___ of ___

Date ________ Flow ________ Examiner ________ T ___ R ___ Sect ___

HABITAT CODE	POOL TYPE	SQUARE YDS SPAWNING GRAVEL	STRUCTURAL ASSOCIATION	LENGTH	MAX WIDTH	MEAN WIDTH	MAX. DEPTH	MEAN DEPTH	UNIT AGE CLASS	RIPARIAN TYPE & HT.	COMMENTS

HABITAT CODE
P-POOL R-RIFFLE U-RUN
G-GLIDE A-RAPID F-FALL
C-CASCADE

TYPE: L-LATERAL SCOUR E-EDDY
T-TRENCH P-PLUNGE D-DAMMED
S-SECONDARY CHANNEL G-SLOUGH
B-BACKWATER

STRUCTURAL ASSOCIATION
B-BOULDER W-LARGE WOODY F-FALLS
E-ENHANCEMENT STRUCTURE U-OTHER
D-BEAVER DAM C-CULVERT T-DEBRIS TORRENT S-STREAM BEND
N-CHANNEL CHANGE

RIPARIAN TYPE
A-ABSENT B BUFFER
N-NONBUFFERED
C-CONIFEROUS
D-DECIDUOUS

WATER QUALITY SAMPLING INFORMATION

NAME OF WATER____________________ BASIN ____________________

SAMPLE SITE LOCATION ____

LAT_______ LONG_______ TWP_______ RNG_______ SECT _______ DATE____________ TIME__________

NAME OF SAMPLER______________ COUNTY______________ PLANNING AREA______________

WIDTH__________ DEPTH__________ FLOW__________ WATER TEMPERATURE______________

MACROINVERTEBRATE SAMPLES____

CO_2______________ PH ___________ SULFATE___________ OTHERS ___________

CONDUCTIVITY _______ OXYGEN _______ ALKALINITY___________ ___________

HARDNESS___________ TURBIDITY _____ ___________ ___________

HABITAT TYPE: POOL ___ RIFFLE___ RUN___ GLIDE ___ RAPID ___ CASCADE ___

SUBSTRATE: BEDROCK ___ LARGE BOULDER __ SMALL BOULDER ___ LARGE GRAVEL ___

SMALL GRAVEL ___ SAND ___ SILT ___ ORGANIC MATTER ___

COMMENTS:

AQUATIC PROJECT DESCRIPTION
WORKSHEET

TYPE OF PROJECT ____

____

LOCATION: STREAM ______________________ BASIN ______________________

T____ R____ SECT_____ LATITUDE_______ LONGITUDE_______ COUNTY______________

DESCRIPTION OF LOCATION ____

____

PROBLEM AND CAUSE ____

____

____

WORK TO BE DONE ____

____

____

EQUIPMENT NEEDS ____

____

COST ESTIMATES: ITEM ESTIMATED COST

IMPLEMENTATION SCHEDULE:
PLANNING WORK EVALUATION

ANTICIPATED BENEFITS ____

____

REMARKS ____

____

Maps, drawings, or other pertinent information, together with photographs, should be attached to this form.

AQUATIC HABITAT FILE INFORMATION

STREAM ______________ TRIB ______________ BASIN ______________ T ____ R ____ SECT ____

LAT ______ LONG ______ MAP NAME ______________ MAP SCALE ______________ DATE ______________

ALTITUDE: UPPER ____ LOWER ____ GRADIENT ______ ACCESS ______

DRAINAGE AREA

1ST ORDER	2ND ORDER	3RD ORDER	4TH ORDER	5TH ORDER	6TH ORDER	7TH ORDER	TOTAL

TRIBUTARY LENGTH

1ST ORDER	2ND ORDER	3RD ORDER	4TH ORDER	5TH ORDER	6TH ORDER	7TH ORDER	TOTAL

PAST TIMBER MANAGEMENT ____

____

____

OTHER USES: FISHING ______________ RECREATION ______________

DOMESTIC ______________ IRRIGATION ______________

DIVERSION ______________ RESERVOIR ______________

OTHER ____

ACTIVITY LOCATION ____

MAJOR SOILS GROUPS BY % ____

____

WATERSHED TOPOGRAPHY ____

COMMENTS ____

____

FISH POPULATION INFORMATION

STREAM____________________ BASIN______________ TRIBUTARY______________ DATE __________

REACH LOCATION ____ T____ R_____ SECT ______

FLOW_______ TEMP: AIR______ WATER_______ EXAMINERS _______________________________

ESTIMATED POPULATION: 0-10 10-20 20-50 50-100 100-200 OVER 200 per 100 M

METHOD OF COLLECTION________________________ COMMENTS______________________________

SPECIES						
POP. EST.						
SIZE DIST.						
WEIGHT						

AQUATIC PROJECT DESCRIPTION
WORKSHEET

TYPE OF PROJECT ____________________

____

LOCATION: STREAM ____________________ BASIN ____________________

T____ R____ SECT_____ LATITUDE_______ LONGITUDE_______ COUNTY____________

DESCRIPTION OF LOCATION ____________________

____

PROBLEM AND CAUSE ____________________

____

____

WORK TO BE DONE ____________________

____

____

EQUIPMENT NEEDS ____________________

____

COST ESTIMATES: ITEM ESTIMATED COST

IMPLEMENTATION SCHEDULE:
PLANNING WORK EVALUATION

ANTICIPATED BENEFITS ____________________

____

REMARKS ____________________

____

Maps, drawings, or other pertinent information, together with photographs, should be attached to this form.